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Photograph by R. L. Taylor

UPLAND COTTON GROWN AS AN ANNUAL CROP IN MISSISSIPPI

Frontispiece

The United States' cotton crop of nearly fifteen million bales is approximately half of the world cotton production.

COTTON PLANTS, TAME AND WILD

THOMAS H. KEARNEY

Bureau of Plant Industry, U. S. Department of Agriculture

The United States' cotton crop of nearly fifteen million bales is approximately half of the world cotton production.

COTTON is one of the most interesting of domesticated plants. Aside from the economic value of its products and the varied agricultural problems involved in its cultivation under a vast range of conditions, it is a fascinating subject for scientific research. The wide natural distribution of the genus to which cotton belongs, the doubtful affinity of many of the wild species, the obscurity attending the origin of the cultivated forms and the complex structure of these highly specialized plants arouse the keen attention of botanists. Geneticists have much to do in solving the problems of inheritance of characters in this group. Physiologists find abundant matter for investigation in the striking responses of the plant to climatic and soil factors. The great variety of insects to which cotton is host give it extraordinary interest in the eyes of entomologists. The antiquity of the cultivation of cotton in many parts of the world draws the attention of ethnologists to this plant. Better understanding of the classification and the geographical distribution, past and present, of the various types of cotton may be expected to throw light on the relationships and migrations of primitive peoples.

Hitherto, botanical study has been limited mainly to the agricultural forms and to dried specimens of wild species preserved in herbaria. It is becoming evident that other material is required in order to solve the problem of classification of the cotton plants and their near relatives. The cultivated forms, alone, do not tell the story and some of the most important characters are shown very poorly, if at all, in dried specimens. To provide better material for investigation, the United States Department of Agriculture is assembling, in California and Florida, collections of living plants of Gossypium (cotton) and related genera. Similar enterprises are under way at the Tropical Research Station on the Island of Trinidad, British West Indies, and at agricultural experiment stations in other tropical countries. It is believed that real progress in classification may be made when it becomes possible to compare the several species, wild and domesticated, growing side by side. Such material will also facilitate the making of crosses to throw further light on affinities and to determine the mode of inheritance of particular characters.

Domesticated in Prehistoric Times

Cotton, like most of the important crop plants, was brought under cultivation before the dawn of history. It is exceptional, however, in having been domesticated independently in both the eastern hemisphere and the western. Wheat, barley, oats, flax, alfalfa and many other of our principal agricultural plants originated in the Old World and were first brought to America after its discovery by Columbus; while maize, tobacco, the potato and the tomato are native American plants and were unknown in Europe before 1492.

The hairs borne on the seeds of the cotton plant have been used since very ancient times in making cloth for human wear and for other purposes. Chemically, they are nearly pure cellulose and recent inventions have so multiplied the number of articles manufactured from them that a complete list would fill several pages. Cotton seeds are rich in oil and this, also, has found many important uses in modern times.

The French botanist Chevalier, having observed that primitive tribes in

PREHISTORIC COTTON FABRIC

Figure 1

Cotton fabrics found in the cliff-dwelling of Betatakin, Navaho National Monument, northeastern Arizona. This community house is believed to have been abandoned 800 years ago. (Courtesy of U. S. National Museum.)

Africa and Indo-China make fish-lines and nets from cotton lint, although they weave no cloth, suggested that this may have been the way in which the plant was first utilized by man. Such use might have led to door-yard or garden culture on a small scale, as is still practiced by many savage and semi-civilized peoples. The system of cotton growing described by Lewton, which prevailed until recently among the Hopi Indians of northern Arizona, was of this type. In the Old World, India seems to have been the cradle of the cultivation and manufacture of cotton. Bits of cloth have been found in the ruins of Mohenjo-Daro in northwestern India, a town which archaeologists believe to have been abandoned nearly 5000 years ago. When the fibers composing this cloth were examined microscopically by Gulati and Turner, they proved to be very similar to the fibers of a kind of cotton still cultivated in India. References to cotton are said to occur in Sanscrit literature of as early as 800 B.C. In the New World, cotton fabrics often well-preserved, have been found in ancient Peruvian tombs and in the cliff dwellings of the southwestern United States. (Figure 1). These fabrics were made from fibers resembling those of cottons growing in America to-day.

The Beginnings of European Contact with Cotton

The Greeks, apparently, were unacquainted with cotton until late in the classical period. Watt remarks that "there would appear to be no doubt that cotton textiles had been carried to Europe, and were regularly traded in, long before any definite knowledge existed regarding the plant or the fibre of which they were made. In fact, the Greeks were first acquainted with the cotton plant through the group of explorers who accompanied Alexander the Great and his immediate successors in India."

The Arab conquests in the Mediterranean region were the occasion of a rapid spread of cotton production westward. There is some reason to believe that the plant was grown in Syria and in Egypt before the beginning of the Christian era. Its introduction into the rest of northern Africa, Sicily and Spain probably was effected by the followers of Mohammed. The development of a flourishing cotton-growing industry in tropical Africa during the Middle Ages seems to have followed Arab penetration of that region. The fact that our word "cotton" is derived from an Arabic word, "qutn," is significant of the manner in which modern European contacts with this plant were established.

The Spanish discoverers and explorers of the Americas found cotton being grown by the natives from the West Indies to Mexico, Brazil and Peru and in some of these countries the art of making cloth was highly developed. A variety of cotton goods were among the trophies sent by Cortez to the King of Spain after the conquest of Mexico. The Coronado expedition of 1540-1542, observed cotton growing among the Indians of Arizona and New Mexico. Spanish missionaries of the eighteenth century recorded the growing, spinning and weaving of cotton by the Pima Indians along the Gila River.

The introduction of this plant into what are now the eastern United States came much later. Cotton was first grown in the colony of Virginia very soon after its settlement by Europeans, according to Bancroft, who wrote: "In 1621, the seeds of cotton were planted as an experiment; and their 'plentiful coming up' was a subject of interest in America and England." Before the end of the seventeenth century, coarse cotton cloth was being manufactured on a small scale in some of the colonies and Thomas Jefferson is cited to the effect that a century later this textile furnished nearly all the clothing of the poorer classes in the southern states. Definite records of exportation of cotton to England from the American colonies

Photograph by C. B. Doyle

TREE COTTON IN SOUTHERN MEXICO

Figure 2

In many parts of the Tropics, cotton plants grow as long-lived perennials, often reaching the size of small trees.

date from 1747. In the year 1794 the exports to Europe had risen to 1,600,000 pounds and two years later the effect of Whitney's invention of the cotton gin was seen in the increase of the exports to 10,000,000 pounds. Before this invention was perfected the labor of removing the lint from the seed had been an almost insuperable obstacle to large-scale production.

Cotton is now an important crop in nearly all tropical and warm temperate countries. In recent years, the annual world production has averaged some 12½ thousand million pounds of lint, of which nearly one-half is contributed by the United States. It is estimated that if all the cotton plants grown annually throughout the world were assembled in a single field, this field would be larger than the combined total area of South Carolina and Georgia.

What Cotton Plants are Like

Cotton belongs to the genus Gossypium, of the Hibiscus tribe of the Mallow Family. Familiar related plants are the showy-flowered rose-mallow, shrub-althea and other species of Hibiscus, including the popular southern vegetable, okra or gumbo. The hairy seeds of other genera of this tribe, not so well-known as Hibiscus but more nearly related to Gossypium, are shown in Figure 7. One of them, Thurberia, is a shrub or small tree native in the mountains of southern Arizona and northern Mexico, which harbors a weevil almost identical with the cotton boll weevil and capable of feeding on cotton.

The cotton plant is a deep-rooted perennial, remaining alive several years where climatic conditions are favorable. Outside the tropics, it is grown chiefly as an annual crop (Frontispiece), but within the tropics perennial or "tree" cottons are extensively cultivated, chiefly for local use (Figure 2). The cotton plants first domesticated by primitive man were probably of the tree type, because all the wild or semi-wild cottons of the world are naturally long-lived plants and are found only in or near the tropical zone. According to Watt, "No species of Gossypium is known, in its original habitat, to be an annual." This author doubtless is right in supposing that annual growth is an acquired habit, the result of selection by man as he pushed the growing of cotton into regions far beyond the tropical zone.

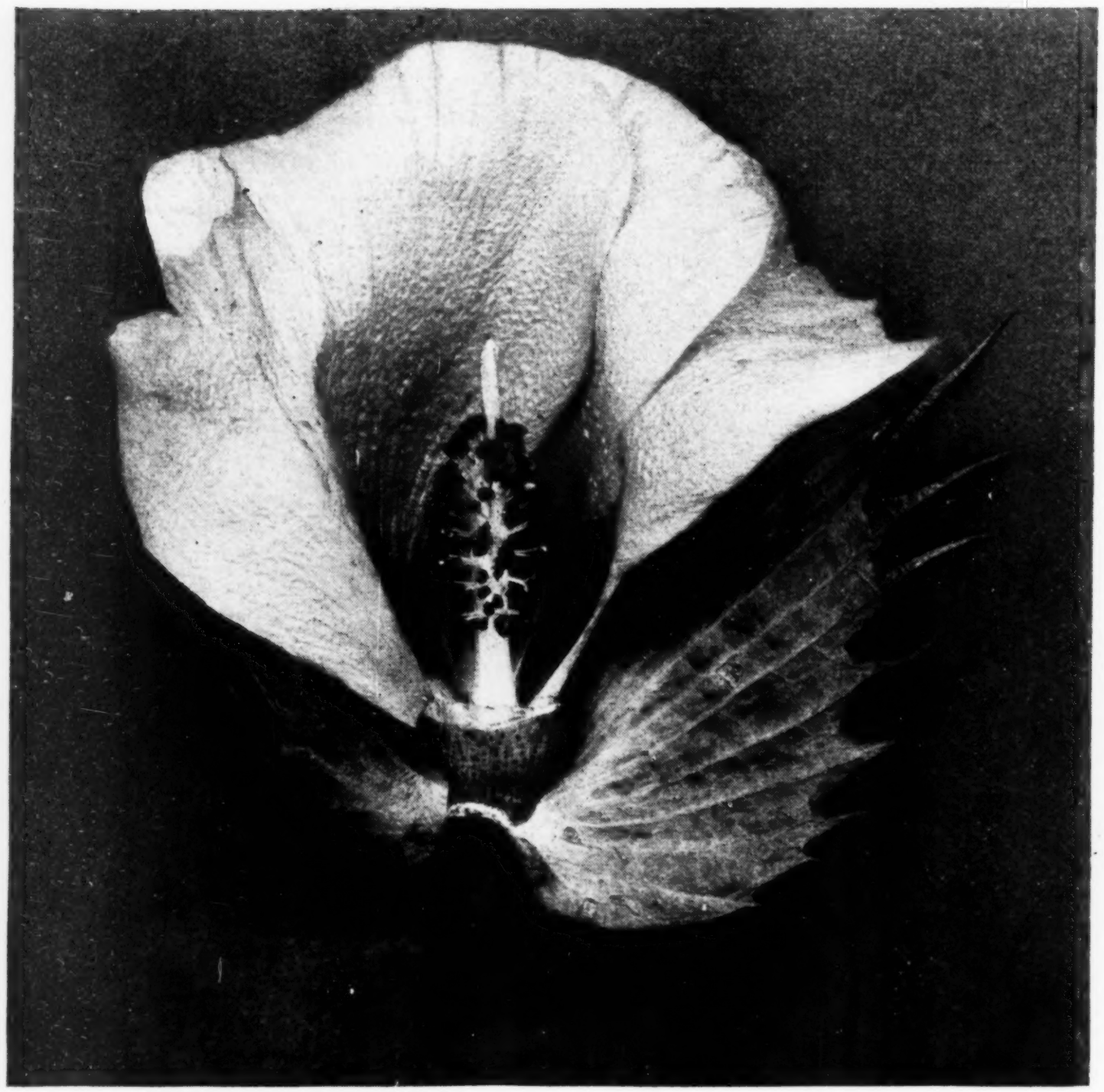
The large and beautiful Hibiscus-like flowers (Figures 3 and 5) are borne, usually singly, at the nodes or joints of the fruiting branches. Only one, or very few blossoms open daily on a plant. The corolla, the showy part of the flower, consists of five petals which vary in color, in different species, from greenish-white to bright yellow, lavender or deep red. In many species there is a large, dark red or purple spot or "eye" near the base of each petal (Figure 5). As with most members of the Mallow Family, the bases of the pollen-containing organs, the stamens, are united into a tube or sheath in which the greater part of the length of the pistil is enclosed.

The seed pods or bolls reach maturity several weeks after the flower has withered. The boll is no larger than a hazel-nut in some species of cotton, as large as a green walnut in others (Figure 4). Its shape varies from conical to nearly spherical. When the boll matures, its thick outer wall becomes dry and splits open lengthwise, midway between each pair of partitions between the cells (Figure 9).

The seeds are arranged in two vertical rows in each cell or lock of the boll. While young they are attached by short stalks along the inner angles of the locks but become detached as they ripen. The ripe seeds have a hard, shell-like outer coat which usually is more or less covered with hair.

Development and Structure of the Seed Hairs

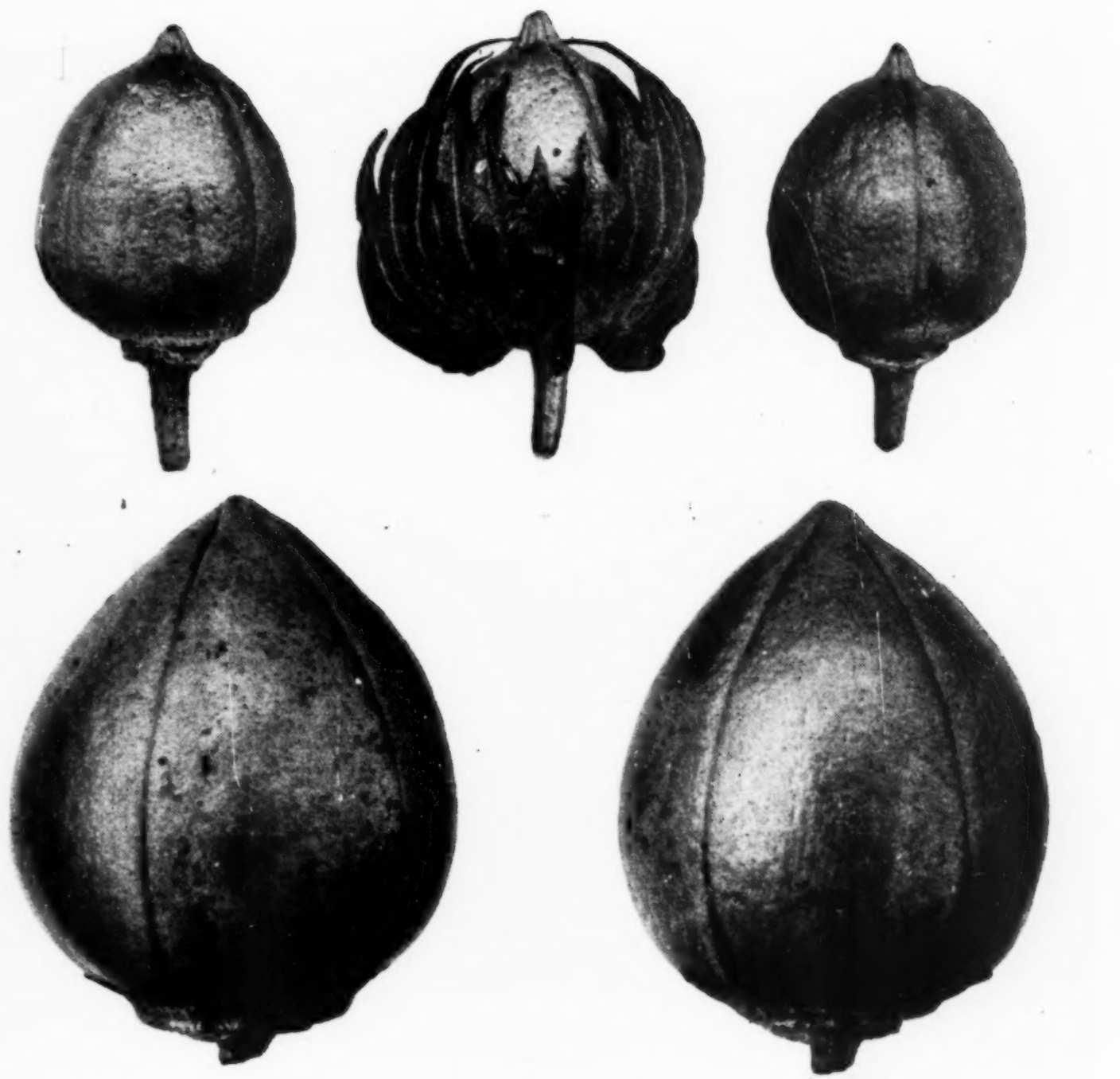
In other genera of the Hibiscus tribe and in certain wild species of Gossypium the hairs of the seed coat



STRUCTURE OF THE COTTON FLOWER

Figure 3

A cotton flower (Egyptian type) with two of the five petals removed to show the reproductive organs (stamens and pistil). The picture shows also a portion of the involucre, a characteristic structure in the genus Gossypium, which envelopes the flower and the ripening boll, and consists of three coarsely-toothed green bracts. (Natural size.)

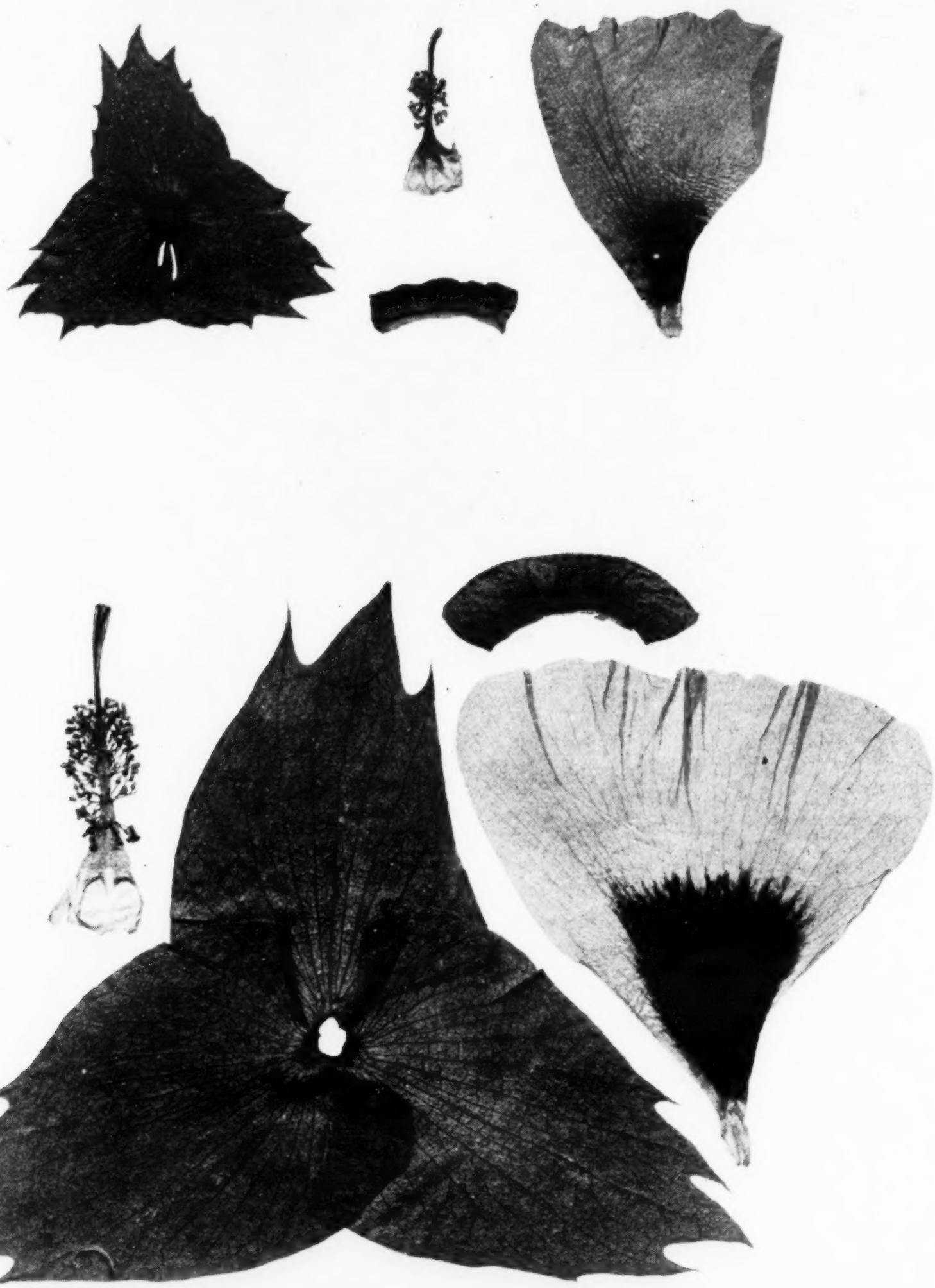


Photographs by H. F. Loomis

UNOPENED COTTON BOLLS

Figure 4

Bolls (seed pods) of Hopi cotton (upper) and of the Acala variety of Upland cotton (lower) with the enveloping bracts removed in order better to show the size and shape of the bolls. (Natural size.)



Photograph by R. L. Taylor

PETAL SPOT IN FLOWERS OF ASIATIC COTTONS

Figure 5

Dissected flowers of Asiatic cottons, characterized by an involucre with partly united bracts and by petals having a very large dark basal spot.

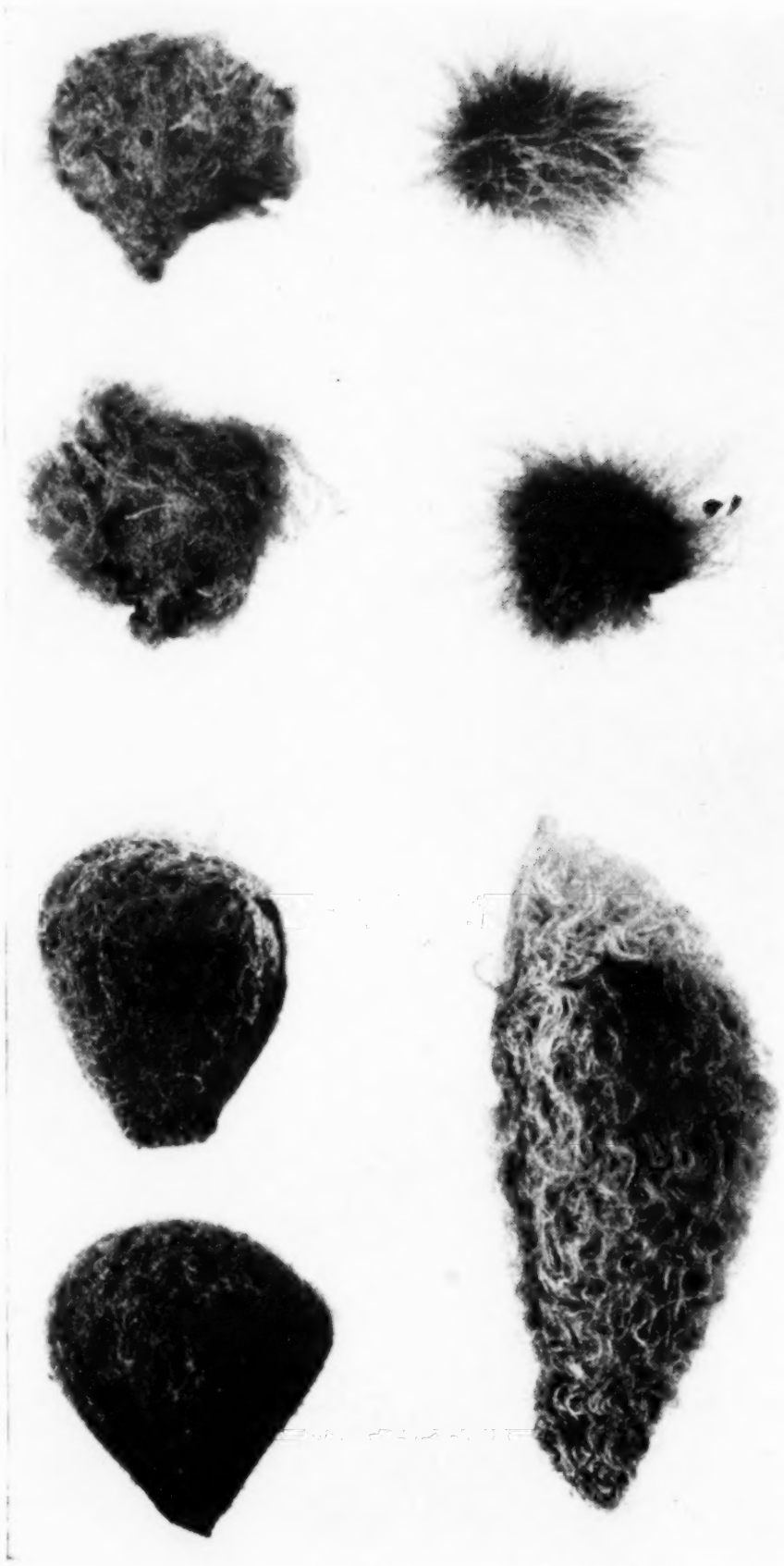
in the genus Gossypium, which envelopes the flower and the ripening boll, and consists of three coarsely-toothed green bracts. (Natural size.)

Photograph by R. L. Taylor

COTTON SEEDS—WILD AND TAME

Figure 6

Seeds of wild cottons (Gossypium): *G. Davidsonii* of the Gulf of California region (upper left); *G. Sturtii* of Australia (upper center); *G. Stocksii* of northwestern India (upper right); *G. tomentosum* of the Hawaiian Islands (lower). Six times natural size. The inserts show naked and very fuzzy seeds (natural size) from different individuals of Upland cotton, after removal of the long lint hairs. The two kinds of seeds were borne on plants that were similar in all other respects. Naked-seeded individuals are found occasionally in plantings of fuzzy-seeded Upland cottons, their appearance being attributed to mutation (spontaneous variation) or to a rare combination of genes.



Photograph by R. L. Taylor

SEEDS OF COTTON RELATIVES
Figure 7

Seeds of members of the Mallow Family nearly related to Gossypium (cotton): *Cienfugosia heterophylla*, of southern Florida, etc. (2 seeds, upper left): *Alyogyne hakeaefolia*, of western Australia (2 seeds, upper right): *Thurberia thespesioides*, of southern Arizona and northern Mexico (2 seeds, lower left): *Erioxylum aridum*, of northwestern Mexico (1 seed, lower right). Six times natural size.

are very short and are all of one kind (Figures 6 and 7). In all cultivated cottons, however, some of the hairs are much longer and the economic value of a particular kind of cotton depends very largely upon the abundance, length and uniformity of these lint hairs (Figure 8). They are true hairs, being simply outgrowths of the epidermis of the seed coat. Although commonly referred to as "fibers," they are very different in origin and structure from the long bast fibers which are extracted from the stems of flax, hemp, jute and many other plants. The seeds of nearly all cultivated cottons also are partly or wholly covered with "fuzz" hairs which are plainly seen after the gin has removed the lint (Figure 6, lower). These originate in the same manner as the lint hairs and differ from the latter only in being shorter and thicker-walled.

The hairy outgrowth develops early, being observable on the ovules the day the flower opens. The further development of the lint hairs is described thus by Balls: "The lint hair itself is a simple unicellular hair, formed by the outward extension of the external wall of a single outer epidermal cell of the outer seed coat. The full diameter of the hair is attained almost at once, when it is only 1/10 millimetre in length, while its length continues to increase until the twenty-fifth day of development, after which its walls begin to thicken, giving strength to the lint."

During the early stages of its development, the lint hair is a cylindrical tube but as it matures the walls collapse and the hair takes the form of a very narrow, more or less spirally twisted ribbon (Figure 10). The most important properties of the lint from the point of view of the spinner are its length, strength and fineness. The strength is believed to be determined largely by the thickness of the walls of the hair. A high degree of spirality, i. e. numerous twists along the length of the hair, is supposed to enhance the spinning value. Other things being equal, very long and fine lint like that of Sea Island cotton (Figure 8), is the most valuable, since it can be spun into yarns of the highest "count" or number of hanks to the pound. It is estimated by Denham that in good Sea Island cotton the length of the hair may be as much

as 4000 times its diameter. To have the same relative dimensions, a rope one inch in diameter would have to be 333 feet long.

Biological Significance of the Seed Hairs

The utility of the seed hairs to the plant itself is not clear. It has been suggested that, like the long hairs of milkweed, dandelion, etc., they aid in the dispersal of the seeds by wind. In all cottons which have long enough lint to make them worth cultivating, however, the matted wad of cotton hairs is peculiarly ill-fitted to aid in the transportation of such large and heavy seeds. Some truly wild species of Gossypium, *G. Sturtii* for example, have much smaller seeds than any cultivated cotton but in these species the hairs are so short and so closely appressed to the seed as to be valueless for dissemination (Figure 6). Seeds of cotton with the lint attached are often utilized by nest-building animals such as birds and rodents and this may be an important factor in distributing the plants. A. K. Fisher, during a recent visit to the Galápagos Islands, collected seeds of wild cotton from the nest of a finch.

Some botanists have conjectured that the cotton seed-hairs may serve the plant by absorbing moisture and retaining it close to the seed, thus facilitating germination. Cotton plants growing in regions where drought occurs periodically might benefit in this way. Cook has advanced the idea that the hairs may help to protect the seeds against injurious insects which puncture them while still young and tender.

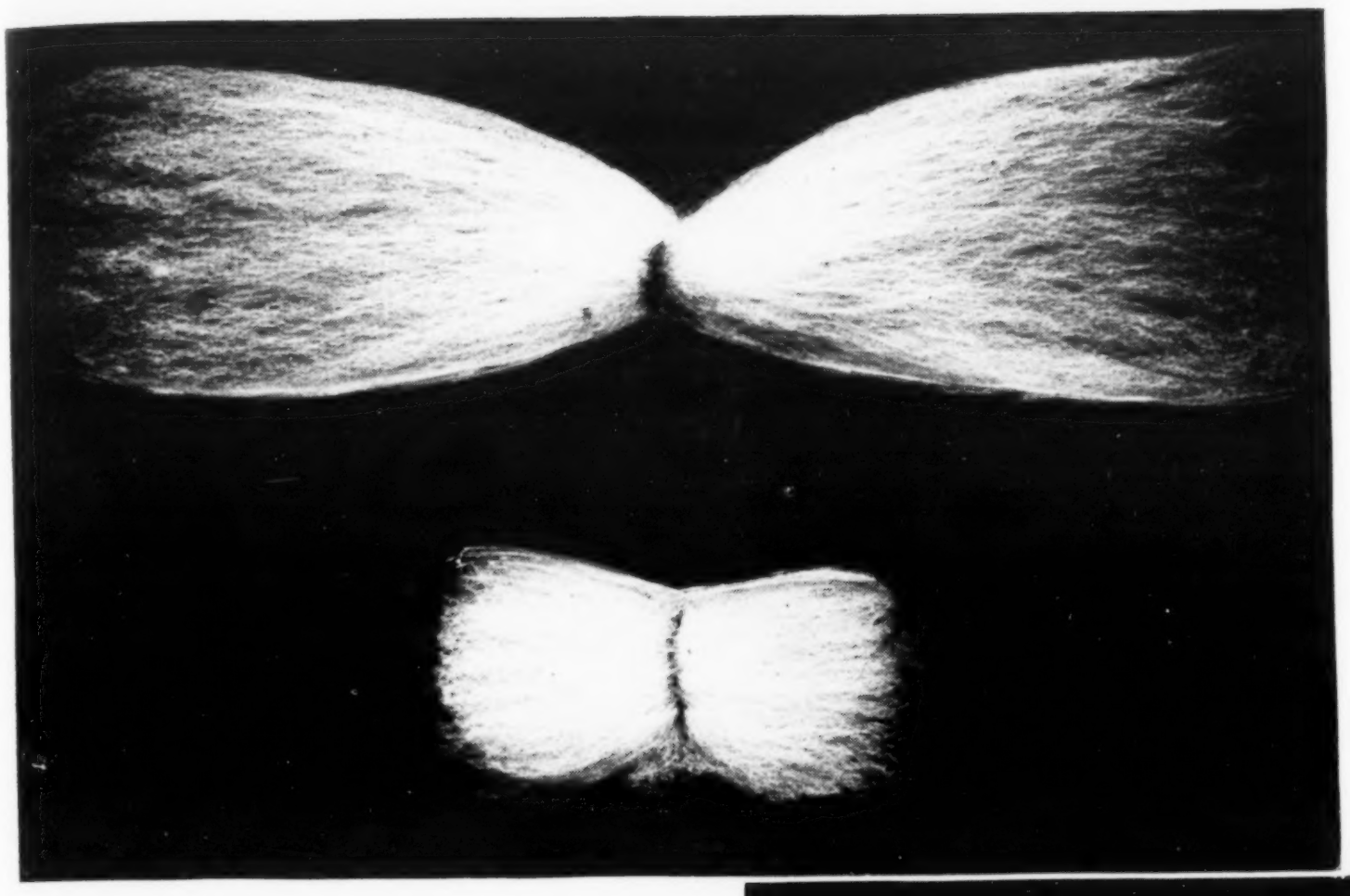
Geographical Distribution of Gossypium

Since cotton plants in the wild are long-lived perennials, the natural limits of distribution of the genus are fixed by climatic conditions favorable to this habit of growth. Zaitzev finds that "with a few exceptions, all these places lie within the limits of the northern and southern isotherm of the coldest month showing 18°C." (64½ degrees Fahrenheit). Evidently the monthly mean temperature is here referred to. With slight deviations, the boundaries of the zone thus defined correspond with the tropics of Cancer and Capricorn. Within this zone conditions are stated to be favorable for the perennial growth of cotton up to an elevation of about 6000 feet. Since all known forms of the genus are sun-loving, it is believed that the original home of these plants was in the more open, and therefore drier parts of the tropics, rather than in densely forested regions.

Selection by man of early maturing forms suitable for cultivation as an annual crop has made possible a great extension of the original limits, so that cotton is now grown in North America as far as latitude 37 or 38, and in the old World even to latitude 46, in the Crimea. Cottons like the Old World *Gossypium herbaceum* and the New World *G. hirsutum* (Upland) which have long been grown as annual crops far beyond the natural limits of the genus, can be cultivated as perennials where climatic conditions are suitable but tend to be shorter-lived than tropical tree cottons under the same conditions.

No truly wild form is known to occur farther than about five degrees beyond the tropics, except possibly in Australia. Within or just outside the tropical zone, wild cotton plants of perennial habit are found in many parts of North and South America, Africa, Asia, Australia and Polynesia. Undoubtedly the genus was widely distributed in both hemispheres long before the plant was domesticated by man. It is the only outstanding example of a genus of cultivated plants of which both Old World and New World species were domesticated independently in prehistoric times.

The genus Gossypium is an old one, geologically. As Balls has pointed out, this is indicated by the occurrence in Australia of wild species, undoubtedly native and showing no relationship to any of the cultivated forms.



VARIATION IN LINT LENGTH

Figure 8

Lint combed out on seed of an Asiatic cotton (lower) and of Sea Island cotton (upper) indicating the range of length in commercial cottons. (Natural size.)

RIPE BOLL OF AN ASIATIC COTTON

Figure 9

The stalk is bent so that the boll hangs downward instead of being erect or ascending as in American cotton. The short, rought lint of this particular variety is used for mixing with wool. (Natural size.)

Photographs by R. L. Taylor

Since the seeds are poorly adapted to wide dispersal by natural means, it is probable that the group had spread to Australia before that continent became separated from other land masses.

Classification of the Cultivated Forms

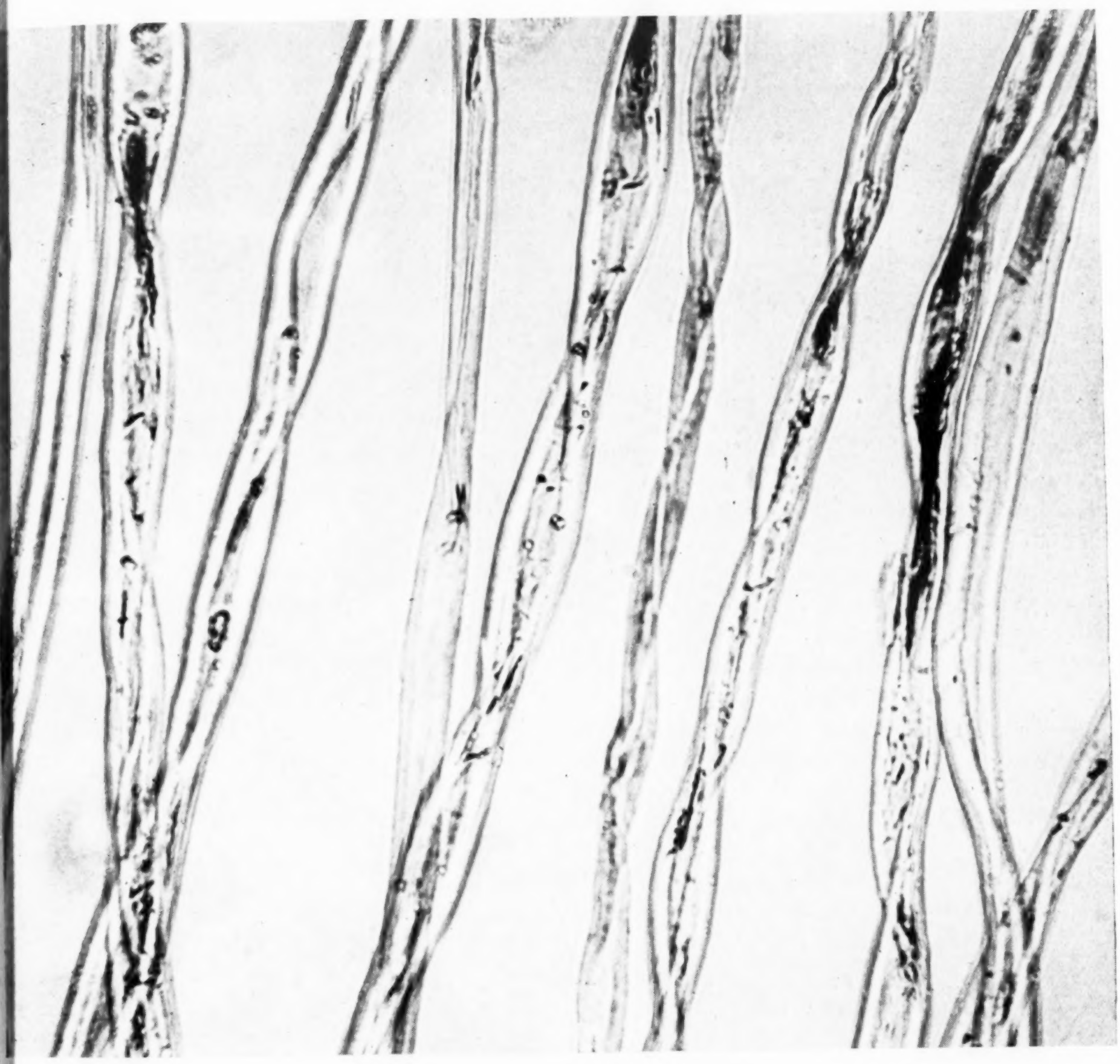
No very satisfactory botanical classification of the genus Gossypium has yet been achieved. A few species in different parts of the world are truly wild and can be defined with precision like other wild plants. But this is by no means the case with the cultivated cottons. As with many of the important crop plants, the ancestral forms either no longer exist in a state of nature or cannot be identified. Cotton was domesticated in very ancient times. The seeds retain their viability many years and could be carried readily from place to place in the migrations of primitive peoples. Cultivation is easy and the plants quickly become naturalized in warm countries. Furthermore, the flower is well adapted to cross-pollination and hybrids between different species are frequently produced under natural conditions. In view of these facts, it is evident that the botanist who attempts to classify the species of Gossypium has undertaken an extremely difficult task. Specific demarkations and original geographical limits in this genus have largely been obliterated.

The most elaborate attempt at a classification of the genus, that of Watt, bases the main subdivisions largely upon the presence or absence of fuzz on the seeds. Recent investigations have shown that this character is inherited in simple Mendelian fashion and that, as a result of hybridization, it can become associated with any other group of characters. It is not strange, therefore, that of two forms otherwise similar, one may have very fuzzy and the other naked seeds (Figure 6). Classification on this basis is necessarily artifical.

A more natural classification has been proposed lately by the Russian plant breeder, Zaitzev, who made use of recent discoveries concerning the minute structure of the reproductive cells. Working independently, Denham in England, Nicolajeva in Russia and Longley in America have discovered that the chromosomes, minute bodies in the cell nucleus which are believed to carry the determiners of characters in all plants and animals, number 13 in the dividing reproductive cells of Asiatic cottons and 26 in the cultivated American cottons. In all groups of plants it is difficult to cross species having different chromosome numbers and this discovery accounted for the known facts that hybrids between Asiatic and American cottons are rarely produced and are invariably sterile.

Zaitzev, therefore, first divides the cultivated cottons into an Old World and a New World group. These fundamental groups are very distinct, not only in their chromosome numbers but in other characters. The Asiatic cottons, as compared with the American, mostly have the lobes of the leaves rounded instead of pointed and broadest near the middle instead of at the base. The leaf-like bracts of the involucre, which partly envelopes the flower, commonly are united for much of their length instead of being free or nearly so. The flower stalks, at least in some of the forms, are curved downward instead of being erect or spreading. In certain Asiatic cottons, the entire corolla is deep red, while no American cotton shows this color in the fresh corolla, except as a sharply defined spot near the base of the petal. (Figures 3 and 9).

Numerous Asiatic forms have been described as species (*Gossypium herbaceum, G. Nanking, G. arboreum, G. obtusifolium*, etc.) but there is much difference of opinion as to the limits of species in this group. Gammie announced that "from a botanical point of view it is clearly evident that we have at most only one true species of cotton in India." Recently this conclusion has been endorsed by Harland



ENLARGED COTTON "FIBRES"

Figure 10

Mature lint hairs of Egyptian cotton, magnified 400 times. Only about 1/100 of the total length of the hairs is here shown. Note the spiral twists which appear in the hairs as they dry out and collapse and which are supposed to contribute to the spinning value of the lint. (Courtesy of Bureau of Agricultural Economics, U. S. Department of Agriculture)

who states: "Genetic studies more and more confirm the idea that there is only one species of cultivated Asiatic cotton, under which can be placed as agricultural varieties the four above ecologically differentiated races." The shortest-linted of the commercial cottons of the world, Indian and Chinese, belong to this group.

Both the Old World and the New World groups are divided by Zaitzev into two sub-groups. His classification seems justified as regards the American group, at least, since two well-marked assemblages are distinguishable, not only by the characters of the plants but by what seems to have been their original geographical distribution. These are the Mexican-Central American sub-group and the South American sub-group.

The first sub-group is represented by American Upland cotton (*Gossypium hirsutum*) which supplies about sixty per cent of the world crop and is now grown in nearly all cotton pro-

ducing countries. The plants as a rule have whitish petals without spots, smooth, rounded, 4-celled or 5-celled bolls, seeds completely covered with fuzz and white lint of medium length. It seems fairly certain that this type originated in southern Mexico or Central America.

The South America sub-group comprises a large number of forms (*Gossypium barbadense, G. brasiliense, G peruvianum,* etc.). The plants tend to be long-lived perennials or even small trees and have, for the most part, yellow petals with dark-red basal spots, rough, pointed, 3-celled bolls, smooth or only partially fuzzy seeds and long, cream-colored or reddish brown lint. The most valuable commercial cottons, Sea Island and Egyptian, belong to this sub-group.

There is no difficult in crossing representatives of the two American subgroups, for example, Upland with Sea Island or Egyptian cotton, and the hybrid plants in the first generation are all alike, very vigorous and perfectly fertile. In subsequent generations, however, there is much sterility and great diversity, with many characters not seen in either parent making their appearance. Such behavior is well-known in the hybrids between distinct botanical species in many genera of plants. On the other hand, there is no such appearance of sterility and of "new" characters when crosses are made between two varieties of Upland cotton or between two varieties of Egyptian cotton.

Both the Asiatic and the American group are represented in Africa by numerous forms, cultivated or growing wild, but it is uncertain whether any of them are indigenous. As regards the origin and classification of its cotton plants, Africa is still the "Dark Continent." Some of the African "species" are very similar to American cottons. Chevalier suggests that they may have been introduced by Spanish and Portugese voyagers soon after the discovery of America and states (translation): "Different American species adapted themselves to different climatic conditions. The heavily forested regions have especially perennial, semi-arborescent species with naked seeds. In the Sudanese zone we find almost exclusively *G. punctatum* with fuzzy seeds, a very near relative of American Upland. It tends to spread through all the vast region between the forest and the desert, and from the Atlantic to Lake Tchad."

Wild Species of Gossypium

It remains to consider a few species apparently never in cultivation and showing no affinity to any cultivated form, which are found in widely separated countries. They are of no economic importance but have great scientific interest. Among these are *Gossypium Davidsonii* and *G. Harknessii* on the shores and islands of the Gulf of California, *G. tomentosum* the Mao or Hulu Hulu cotton of the Hawaiian Islands, *G. Sturtii* in Australia, *G. Stocksii* in northwestern India and southeastern Arabia, *G. Kirkii* in eastern Africa and *G. brevilanatum* in Madagascar. All of them are found growing under such conditions as to leave no doubt that they are truly endemic. Seeds of four of these species are shown in Figure 6. They have in common the peculiarity that the seed hairs are all of about the same length, with no sharp differentiation into lint and fuzz. The hairs may be so short and scanty that the seed coat appears naked unless examined closely (*Davidsonii, Sturtii*) or the hairs may be so long as almost to deserve the name of lint (*tomentosum*). In the wild cotton of northwestern India (*Stocksii*) an intermediate condition exists, the seed hairs being fairly long but densely curled and, in their natural position, lying close against the seed coat.

These truly wild species do not fit into the scheme of classification outlined on preceding pages, which applies only to the cultivated cottons and nearly related wild or semi-wild forms. Zaitzev regards them as not properly

belonging to the genus Gossypium. This is an extreme view but unquestionably, in some of their characters, they form connecting links with other genera, as was pointed out by Watt. It is remarkable that *Gossypium Davidsonii,* although a native of North America, has 13 chromosomes, the number characteristic of the Asiatic group, but there is no other resemblance. Thurberia, a plant very nearly related to Gossypium, and like *G. Davidsonii,* found in Sonora, also has 13 chromosomes.

Much more closely related to the cultivated cottons are numerous forms growing wild in the tropics of both hemispheres and having well-developed lint, spinnable by primitive methods although inferior to modern commercial cottons. Many of these have been described as species but all are open to the suspicion of being relics of ancient cultivation. Chevalier has pointed out that within the last century many primitive tribes who formerly grew cotton for domestic use have abandoned the art for the reason that goods manufactured by the industrial nations are now accessible to them at low prices. He adds (translation): "There is no doubt that the culture of the precious textile was much more developed when the first explorers traversed these countries [tropical Africa, Madagascar, Indo-China] than is now the case. . . . . The great territory which is now French West Africa produced more cotton in the middle of the eighteenth century than the American cotton belt then supplied, but in Africa this textile was consumed on the spot."

Doubtless, in still earlier times, war and pestilence led to the abandonment of many sites throughout the tropics where cotton had been grown and where, under favorable climatic conditions, the plants would persist and propagate themselves without human aid.

Tree cottons found in southern Florida and the adjacent keys are the only members of the genus which persist as a wild growth in the continental United States. They sometimes colonize ancient shell heaps and show no evidence of ever having been cultivated, yet the seeds bear lint of appreciable length and the characters of the plants are not unlike those of certain cultivated forms of the American group. Similar plants grow wild in various parts of the West Indies and Central America (Figure 2). The same considerations apply to a wild cotton of the Galápagos Islands, which is probably the *G. Darwinii,* first collected by Charles Darwin during the voyage of the Beagle. There is, however, another species (*G. Klotzschianum*) in those islands which, apparently is unrelated to any cultivated form.

Origin of the Modern Commercial Cottons

What manner of cotton plants were first brought under domestication by primitive man, we shall never know. Presumably they had better-developed lint than most of the truly wild cottons whose seeds are shown in Figure 6 since otherwise no possible utility could have suggested itself. Yet none of the existing forms producing spinnable lint and now found growing in the wild, can be said definitely never to have been under cultivation. The dilemma is thus stated by Chevalier (translation): "In central Africa, species whose lint exceeds 15 millimeters [about one-half inch] in length exist only in cultivation or naturalized around villages and on ancient culture-sites. The spontaneous forms from which they were derived are probably extinct. In reality, the cultivated species, even those having the shortest and coarsest fibers, are the results of centuries of more or less conscious selection by man."

There is scarcely greater certainty about the immediate ancestry of the types now in cultivation. Much difference of opinion exists even regarding the derivation of Sea Island and Egyptian cottons, although they are

supposed to have existed in their present state of development not more than a century or two. Only varieties originated within the last 50 years may be said to have a recorded history. It is not improbable that all of the principal cultivated types had a mixed or hybrid ancestry, and that none of them is descended from a single natural species.

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Hereditary Predisposition to Neuroses

Dr. Burrill B. Crohn, Associate Physician at Mount Sinai Hospital, New York, discussed the relation of neuroses to gastro-intestinal disorders, and said that many forms of intestinal disturbances may be laid at the door of mental ills. In his list of causes of mental and nervous conditions Dr. Crohn placed heredity first, as "a close observation of family groups makes it soon evident that certain behavior and mental traits are constant factors in more than one member of a family." Admitting the importance of environment and association, he said they were secondary, as the two are "chosen and predetermined in largest degree by the constitutional trend of character which deliberately chooses, by inherent preference, to build up such environment."

Mental Hygiene Bulletin, December, 1929.

STUDENT TEST-SCORE RANK AND FAMILY SIZE

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ANYONE who has paused for reflection, during a course in Eugenics, must have been struck with the fact that ours is a melancholy subject. Dysgenic trends are so repeatedly to be exposed, by an instructor, that if he is logical he must be somewhat pessimistic. The eugenic investigator probes, with data-gathering pencil, for sore spots within the body politic, and as he later grinds out the truth the calculator's metallic voice rings a monotonous, and we hope onomatopoeic, *mene mene takel upharsen.* In a presentation of eugenic facts we only too often stand Cassandra-like prognosticating woe. Any harbinger of ill must, in time, stimulate resentment. Partly because of this, possibly because the eugenist is frequently a propagandist as well as an expositor and because eugenic subjects may be adapted only too readily to the sensational exposition characteristic of best sellers, a considerable antieugenic reaction has been recently observable.

Knowing the symptoms, and thoroughly appreciative of what prompts them, we can be tolerently amused by the gibes of intellectual "enfants terrible". Challenging statements, however, are by no means restricted to men of this ilk for they have also been made by responsible scientists. Thus Pearl, after a valuable independent demonstration of differential fertility in occupational groups in the United States, exclaims: (p. 115) "But what of it?" and, "In short we *need* to have laborers reproduce faster than the first six occupations on our list". In like manner Thompson (p. 509) with hardy optimism remarks: "When I consider that by far the largest part of our increase is coming from farmers, immigrants, and the poorer paid industrial workers, who are the children of either farmers or immigrants, I find no cause for worry as to the quality of the next generation". These are only expressions of opinion but they emanate from two prominent students of population. It is rather noticeable that later in his article each author modified an attitude calculated to make the eugenist somewhat restive by comments upon an aspect of population movement which many have already seen with considerable satisfaction. Pearl (p. 116), rather guardedly concludes that: "The falling birth rate and death rate and the type of occupational differential fertility discussed in this paper are primarily to be regarded, I believe, as adaptive regulatory responses—that is, biological responses—to evolutionary alterations in the environment in which human society lives". Thompson (p. 512) hits the manner much more directly with the statement: "Already, there is some evidence that a change in the processes of population growth is under way, and that the present differentials may not long endure".

It is probably too much to expect that the eugenist will be able to relinquish rapidly the somewhat Isaianic attitude which the researches of the last few decades have forced upon him. Certainly he need not hurry the removal of the sackcloth because he expects a grateful populous will replace it with garments symbolic of Mosaic leadership. Nevertheless there are a number of signs that the difference in fertility between intellectually gifted and intellectually less gifted people is being materially reduced and even in rare instances, turning in favor of the presumably superior types. This brings us to the presentation of our own studies which we hope we have tactfully prepared for.

We have gathered, during the last two years, some facts about the families from which Oregon students come. We felt that this by no means novel activity was justified because the population of this university had not been reported upon previously and because we had ready access to the results of the A. C. E. mental test which all freshman students take upon entrance. Dr. H. R. Taylor, who has had charge of this test for the last four years, feels that the technique of administration is very well standardized. We take this opportunity of acknowledging our indebtedness for the mental test data and for the permission which a number of instructors gave us, to obtain other information in their classes.

This information was obtained from freshman students upon questionnaire blanks. The material from the questionnaire blanks was tabulated and then the blanks sent to the students' parents for verification of the answers. Over ninety per cent of these was checked by parents and returned, often being accompanied by letters containing more detailed information. This was a rather gratifying response. Where sibs returned blanks, only one of them was used in the computations. We did not include, either, any data handed in by Asiatic students.

It might be incidentally remarked that the university gets what the dean of the college characterizes as a "field run" of students, the state standing fifth in the Union in the proportion of the population that goes to one or other of the so-called centers of higher learning. Thus we suppose that our student population, when compared with others, presents a somewhat less than average difference from the state population as a whole.

Student Family Size

Oregon is often, and with some justification, referred to as a conservative state. Nevertheless, in the population that we studied, the families proved to be thoroughly modern in point of size; the average for 707 probably completed families being $3.31 \pm .05$ children. Incidentally the mothers of these students came from families averaging $5.60 \pm .07$ and the fathers from families averaging $5.82 \pm .08$ children. The frequency distributions of these three groups are presented in Table I. Parent family numbers are taken from parentally corrected blanks only. We felt justified in using student family data from an additional 75 blanks, not returned by parents, for the students rarely make mistakes in tabulation in the number in their own families.

When the data were subdivided in terms of the occupation of the students' gainfully employed parent we were pleased to note that although the various groups, with one exception, occupied their expected positions, there was very little difference in fertility. Average family size was very much the same in all of the groups which usually have an urban environment and there was rather less than the usual disparity between urban and rural families in point of size. The figures upon average family size and average test score percentile rank are presented in Table II.

The comparative position of students from various occupational groups, insofar as their averages for test score and family size are concerned, makes it obvious that these two things are negatively correlated in the population we are considering. We felt that the size of the correlation coefficient for these two variables was worth determining although its use for the material in question is open to two major criticisms. The data from family number and percentile rank give two types of curves, neither of them the normal distribution which the use of the Pearsonian formula for the derivation of the correlation coefficient presumes. In addition to this purely mathematical weakness, which is present in a good many studies in which the coefficient of correlation is employed, there is an

obvious statistical weakness. There is probably some tendency for only the most promising children of certain families to go to college. Other things equal, the larger the family the more chance it has of sending a promising member who, upon arrival in college, will prove to have a high test score. Instances of this sort would tend to reduce the size of the coefficient of correlation for test score rank and family size if, in the population studied, negative correlation of these variables were actually present. An estimate of how much selection of children for college attendance has taken place in the population we are studying is, of course, quite impossible. We are therefore, in Table III, presenting the coefficients of correlation between students' family size and percentile rank for what they are worth. They undoubtedly give a fair indication of what correlation is present. All the coefficients are small but where correlation is apparent it is negative in sign. Two coefficients, those for Group 2 and for the entire population, are statistically significant. We may therefore make the inference that there is, throughout the population now sending students to the university, a real although probably a rather small tendency for the higher test score students to have come from smaller families.

Discussion

The average of 3.3 children born in families from which Oregon students are now coming is the same as that reported by Baber and Ross for North Central States and rather lower than the average of 3.66 reported in 1924 by Holmes for California. All these figures are distinctly below the average of 4.32 reported by Thompson for the United States, but his average was weighted by a large number of families from the southern states.

It has been estimated by Dublin that, given the marriage and mortality rates of the U. S. registration area of 1920, an average of 3.1 children in families will just maintain the population. Holmes supposed that an average of 3.66 children would not maintain the group he studied because of its lower marriage rate and greater number of childless families, and because the larger the family, other things equal, the more chance it would have of being represented in his sample of students. This last circumstance compelled the inference that the average number of children obtained (3.66) was above the true average for the population in question. However, to offset a lower marriage and birthrate there is undoubtedly a lower mortality rate in families from which students come, while the greater chance of representation of larger families in the college sample is reduced materially by a tendency for people with smaller families to send all their children to college while people with larger families can often send only certain ones. We do not know therefore, whether we are, or are not, justified in asserting that the population which is sending students to the University of Oregon is not reproducing itself even if an average of 3.3 children born per familiy is suspiciously low. The uniformity in average family size in the various occupational groups is some indication of a continued tendency towards the parity in reproduction which the eugenist would like to see.

There have been a number of investigations of the correlation that exists between the intelligence scores made by school children, and the size of the family from which they come [2, 4, 6]. All coefficients obtained were negative and usually in the neighborhood of .30 in point of size. The populations involved in the computations are not quite comparable with our own, for every family can be expected to contribute representatives to the public school while a much lesser number sends students to college. That a selected population need not greatly reduce negative correlation of the variables in question is shown,

however, by Terman's coefficient of $-.27\pm.06$ based upon the I. Q. and family size of 90 gifted children.

The negative coefficients of correlation between test-score rank and family size, which we obtained, are smaller than any previously reported. While we hope that this means that more intelligent parents in our population are now producing families which are more comparable in size with those of less intelligent parents, we have to admit our ignorance of how much this correlation may be affected by a tendency for large families to be represented only by their more intelligent members.

Summary

1. 707 families who are sending students to the University of Oregon had an average number of children born of $3.31\pm.05$.

2. Five occupational groups showed considerable uniformity in the average number of children per family, all averages lying between three and four children. Families of business and professional men averaged slightly below and families of farmers and foresters somewhat above the average for the families in the whole group.

3. Where there was correlation between mental-test score rank and family size the correlation coefficient was negative in sign and small in size.

4. The authors feel that their results, when compared with those of other investigations, are somewhat indicative of progress toward an elimination of the differential birth rate

Table I. Number of Children Born in Students' and Parents' Families

No. in Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Fathers'	29	52	64	97	92	63	63	54	34	29	24	11	11	5	3	631
Mothers'	21	56	86	98	84	68	53	58	52	15	18	14	6	2	-	631
Students'	96	202	160	106	55	31	24	14	8	6	1	2	2	-	-	707

Table II. Family Size and Test-score Rank in Occupational Groups

Occupational group	No. of families	No. of children born		Test-score percentile rank	
		Mean	Std. dev.	Mean	Std. dev.
Professional	192.	3.15±.08	1.69±.06	55.63±1.35	27.75± .96
Trade	232.	3.19±.09	1.98±.06	48.71±1.14	25.85± .81
Skilled labor	102.	3.32±.13	1.94±.07	51.86±1.88	28.14±1.33
Farm and forest	105.	3.94±.17	2.54±.12	43.00±1.71	25.83±1.20
Semi-skilled & unskilled labor	76.	3.30±.16	2.11±.12	45.26±2.02	26.15±1.43
All	707.	3.31±.05	1.99±.04	49.92± .69	27.02± .48

Table III. Correlation of Test-score Rank and Family Size

Occupational group.	No.	Correlation
Professional	192	-.13±.05
Trade	232	-.16±.04
Skilled labor	102	-.10±.07
Farm and forest	105	+.01±.07
Semi-skilled and unskilled labor	75	+.03±.08
All	707	-.14±.03

usually seen in comparisons of occupational groups.

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A Wool Researcher's Handbook

TECHNIK DER HAAR- UND WOLLEUNTERSUCHUNG, *by* C. Kronacher und G. Lodemann (Technic of hair and wool research). 432 pp., 214 text figures; paper bound 30 marks, cloth bound 33 marks. Urban & Schwarzenberg publishers, Berlin and Vienna, 1930.

Recent years have witnessed a rising interest in the body covering, in the physiological agencies which influence it, and in the dependance of its characteristics upon internal secretion and other constitutional and environmental factors. Increased attention also is paid to genetic factors involved in the expression of the different traits of hair and wool. In Germany, Kronacher and his pupils have done much valuable work in studying breed differences in microscopic hair structures of domestic animals (cattle, horses, swine), and they have made special efforts to increase our knowledge of structural and physical traits of wool in different breeds of sheep. Thus, the book which Kronacher and Lodemann now present is based upon a wide experience with the subject and a thorough knowledge of the technical problems and difficulties encountered by the student in this field of research; it also is based upon a profound knowledge of the literature.

The book is opened by general instructions for the collecting of material and its preparation for investigation. The next chapter deals with methods for the study of individual hairs: macroscopic (shape and length); microscopic (imbedding and clearing, study of the surface of hairs, sectioning, methods for measuring the diameter, the use of polarized light, dark field, X-rays, and light of short wave length for structural investigations); chemical methods (micro-reactions and tests for imperfections of the texture of hair); methods for studying the mechanical properties of hair (tension, elasticity, strength, torsion resistance, and so on). The fourth chapter contains a discussion of the methods necessary to study the different hair constituents (cuticula, cortex, medulla, and pigment). There follows a short survey of the specific traits characterizing the hair of different animals. This is followed by a chapter dealing with methods for studying growth and moulting of hair; density, arrangement, and trend of the hairs; special methods for wool research. The two concluding chapters are concerned with methods for studying the skin (with special reference to hair growth and other hair problems), and with pathological conditions of hair and the technical requirements for their investigation. There is a literature list of thirty-five pages. On the whole, this book gives a clear and well balanced account of all methodological questions relating to hair and wool research, and, as a single source of information, it appears to be unique in this field.

Walter Landauer.

FOLIACIOUS CALYX OF THE YOUNG DEWBERRY

Figure 11

This "metaphanic" variation is a modification of the calyx in the direction of a leaf. In response to some condition a considerable percentage of the berries of this variety at Willard, N. C., have one or more enlarged calyx lobes. At the right a double berry shows one enlarged calyx lobe. The tendency to form leaves in place of sepals is a genetic character appearing only under the stimulus of an undetermined environmental condition. GEO. M. DARROW.

DOCUMENTARY EVIDENCE CONCERNING WILD MAIZE IN MEXICO

A Contribution towards the Solution of the Problem of the Origin of Cultivated Maize

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HAVING been much interested in the problem of the origin of cultivated maize I have gradually brought together the documentary evidence I have come across during the course of my researches in other lines and here present them as a contribution to the literature on the subject.

The oldest is the ancient Mexican legend of the origin of maize which was recorded in the Aztec language, written with Spanish characters, by an anonymous writer in 1583, or 64 years after the Conquest.*

According to this, after the gods had created men the latter asked "what shall we eat, oh gods? we are all searching for food." Whereupon, immediately, the ant went to fetch grains of shelled maize from the interior of its "hill of provisions." One of the gods† met the ant and asked "to what place did you go to fetch these? Tell me." But the ant would not tell. The god worked hard questioning the ant who finally told him that he had brought the shelled grains of maize from a place close by. Then the god transformed himself into a black ant and was led to the "hill of provisions' and entered it, and the god and ant overcame and made the red ant prisoner and brought him to terms in order to increase the amount of maize, which they then took to the home of the gods who immediately ate it. They then said "What shall we do with the 'hill of provisions'"? One of the gods, trying to lift and carry it, tied it with cords but could not raise it. Then a goddess began to draw lots with grains of maize and to prognosticate and she and her husband said "for certain the only way to shell maize is for the sun god to beat it at the "hill of provisions". They truly cast lots with grains of maize and then all the rain-gods heaped earth. . . As soon as the sun-god shelled the maize, beating it, the rain-gods snatched the grains from him. . . . they also snatched all food-plants or provisions . . ."

This poetical native legend establishes that the Ancient Mexicans attributed to the red ants the first shelling and storing of grains of maize in their "hills of provisions" and to the sun and hero-god the shelling of maize near the ant-hills, the rain-gods immediately snatching away the grains and making heaps of earth, evidently for the purpose of growing them.

The shelling and cultivating of maize in proximity to ant-hills is particularly interesting in connection with the recently recognized fact that formic acid is a powerful stimulant to plant growth. The ancient legend thus appears to be based on actual observations and experience.

One hundred and sixty-three years after the above legend had been recorded, Chevalier Boturini, famous Italian historian and traveller, published the following native tradition, concerning the origin of agriculture which he had acquired in Mexico and which vaguely recalls Charles Lamb's

*"Legenda de los dos Soles con otras legendas" translated and published by Francisco del Paso y Troncoso. Florencia, 1903.

†The Aztec names of the gods are omitted here, being unessentiai and difficult to pronounce and print. They can be ascertained by reference to the Troncoso publications.

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...ght a double ... GEO. M. DARROW.
...acter appearing ... environmental condition.

account of the discovery of roast pig. "The ancient founders of native civilization, having come to a country covered with forests filled with wild beasts, were forced to clear the land by setting fire to the trees, so as to ensure their safety from the wild animals. While doing so they noticed that the grains of maize and other plants which the fire had roasted were very delicious to the palate, for which reason they collected and kept such grains as were untouched by fire in order to plant them in the same soil, and they thus obtained the harvests they desired."*

The Chevalier Lorenzo Boturini Benaduci, celebrated for having made the greatest collection of ancient Mexican picture writings and documents ever brought together, went to Mexico in 1735 and spent the eight following years in enthusiastically investigating its past history, this being as he writes, "a subject that was dying out and clamored to be extricated from its tumulus of oblivion."

In the preface to his book he relates how, in quest of historical data, he had "exposed himself to the inclemencies of the climate and infinite discomforts and travelled long distances often without finding shelter."

That he was an enthusiastic lover and observer of nature is proven by his casual remarks: "In designating the tassels of the ears of maize I shall employ the elegant metaphor 'golden locks'; as agriculture has always been a fascinating delight to me."† Chevalier Boturini's contemporaries praised him as a prodigy of learning and Doctor Borrull, Professor at the University of Salamanca wrote that he "had sounded and discovered in Boturini a singular talent, utmost powers of penetration, indefatigable industry, cautious judgment and well balanced critique." He calls him "an ornament of all sciences and a stranger to none, being indeed, very much at home in Natural and Moral sciences, etc., and all kinds of erudition, also an expert in European languages."

CHEVALIER BOTURINI

Figure 12

Who in 1746 published an account of a Mexican plant, "a wild maize that grows amidst the forests or woods—whose few grains are of a more delicate flavor than the cultivated kind."

The foregoing tribute to Chevalier Boturini's intellect and capacity for making accurate and careful observations and cautious statements lends great weight to the following which can but be of utmost interest to the botanists who have recently been dealing with the problematic ancestry of cultivated maize.

Boturini asserts: "I found, in New Spain, a wild maize that grows amidst the forests or woods, especially those in the hot lands, with a small ear,

*Idea de una nueva Historia general de la America Septentrional por el Caballero Lorenzo Boturini Benaduci, Madrid, 1746, p. 21.

†"Yo nombraré, con elegante metafora, las barbas de la mazorca de maiz, "cabellos de Oro," pues fué siempre la Agricultura el hechioz de mis deleytes." (P. 24, op. cit.)

whose few grains are of a more delicate flavour than the cultivated kind, as though Nature had located in them, as in a compendium, all of its essence."*

The fact that modern botanists have hitherto sought in vain for "wild maize" may possibly indicate that since Boturini described what he believed to be such; designated its habitat, tasted and enjoyed its delicate flavour, it may have become as extinct as the native dog of Mexico which was a favorite food of the Mexicans and the Spanish Conquerors in the sixteenth century. In the high plateau of Mexico there have been several factors which, combined, would naturally bring about the gradual extermination of "wild maize" during the four centuries that have elapsed since the Spanish Conquest.

The steady increase of cultivated areas and the wide spread and complete deforestation of vast regions of Central Mexico would obviously deprive the plant of its native habitat.

On account of its deliciousness as a food, it would annually be sought for and its ripe grains consumed, especially during the famines that followed the wide-spread destruction of cultivated crops caused by the periodically recurring plagues of grasshoppers.

The record, by a scholar of Boturini's standing who was also a true lover of Nature, to whom "agriculture was a fascinating delight" and who considered his finding of wild maize and the native tradition concerning its cultivation as worthy of special mention in his historical work, deserves respectful consideration. This testimony about its habitat agrees with the native tradition that it grew in woodlands and his statement that its ears were small and had but few grains reveals that the difficulty of shelling them could not have been as great as in the case of the cultivated maize.

The combined documentary evidence submitted reveals that no final conclusion on the problem can be reached until a careful study be made of the habits of ants, birds and the rodents which might serve as agents for the storage and scattering of seeds in the wooded highlands, including the Central plateau of Mexico and extending southward from this reputed place of origin of the hybrid cultivated maize. A belief in the possibility that survivors of "wild maize" may yet be found and identified by trained botanists is encouraged by the report received by the writer from the explorer, Mr. Oliver La Farge, and given in full below.† This account of a kind of food-plant which grows wild in Guatemala and has small ears and the "unmistakable flavour of maize",

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*"Hallé yo en la Nueva España un maiz silvestre que nace entre bosques especialmente de tierras calientes, de chica mazorca, cuyos pocos granos son de sabor más delicado que el cultivado, como que coloca en ellos la naturaleza en compendio toda la sustancia." (P. 21, op. cit.)

†Extract from a letter to Mrs. Nuttall from Mr. Oliver La Farge of the Department of Middle American Research. The Tulane University of Louisiana, New Orleans, dated August 22, 1927.

"Mr. Frans Blom was very much interested in the advance information you sent him and showed me the part of your letter about the maize . . . suggesting that I write you about something that came up on our trip which might be of interest to you.

"With regard to wild maize: At the finca Chanquejelvé, between Menton and Chaculá in Guatemala at an altitude of 5,000-6,000 feet, we were given what we should have taken to be elote (young ears of corn) still in the milk, save, that in early May, the milpas (corn fields) had only just been planted. They were ears about two inches long, or a little longer, looking rather like oat-sheaves without the whiskers, and having the unmistakable flavour of corn. They were said to grow wild in that section. In the district, and around Jacaltenango, there grows wild a very tall grass which looks just like silage corn run to seed, called, I believe *sal-icim* by the Indians, who say that its ears are edible, and also its tassel. This is green during the rainy season."

justifies the suspicion that this may be identical with the plant Boturini described. It will be for competent botanists to determine whether this can be rightly described as "wild maize" or not.

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

THE USE OF THE MICROSCOPE, *by* JOHN BELLING, Cytologist, Carnegie Institution of Washington. Pp. 315. 27 Chapters. Price, $4.00. McGraw-Hill Book Co., Inc., New York. 1930.

THE BIOLOGICAL BASIS OF HUMAN NATURE, *by* H. S. JENNINGS, Henry Walters Professor of Zoology and Director of the Zoological Laboratory in the Johns Hopkins University. Pp. 384. 16 Chapters. 51 Illustrations. W. W. Norton & Co., Inc., New York. 1930.

THE HUMAN MIND, *by* KARL A. MENNINGER. Medical Director, Menninger Psychiatric Hospital, etc. Pp. 447. $3.50. 8 Chapters. Alfred A. Knopf, New York. 1930.

TWINS, Heredity and Environment, *by* NATHANIEL D. MTTRON HIRSCH, Director of Research, Wayne County Clinic, Detroit. Pp. 159. 10 Chapters. Price, $2.00. Harvard University Press, Cambridge. 1930.

HEREDITY IN LIVE STOCK, *by* the late CHRISTIAN WRIEDT, Minister of Agriculture, Norway. Pp. 179. 18 Chapters. 70 Illustrations. Price, $3.00. Macmillan & Co., London. 1930.

HEREDITY IN MAN, *by* R. RUGGLES GATES, Professor of Botany in the University of London. Pp. 385. 16 Chapters. 87 Illustrations. The Macmillan Co., New York. 1929.

POPULATION, *by* CORRADO GINI, SHIROSHI NASU, OLIVER E. BAKER, and ROBERT R. KUCZYNSKI. Pp. 312. 4 Parts. Price, $3.00. The University of Chicago Press, Chicago. 1930.

EXPLORING FOR PLANTS, *by* DAVID FAIRCHILD. Pp. 591. 43 Chapters. 190 Illustrations. Price, $5.00. The Macmillan Company, New York. 1930.

ETUDES SUR LES BUPRESTIDES DE L'AFRIQUE DU NORD, *by* ANDRE THERY, President de la Societe des Sciences Naturelles du Maroc. Pp. 586. 167 Figures. Price, 80 Fr. L'Institut Scientifique Cherifien, Rabat.

THE LEGAL STATUS OF EUGENICAL STERILIZATION, *by* HARRY H. LAUGHLIN, Director of Eugenics Record Office. Supplement to the Annual Report of the Municipal Court of Chicago for 1929. Pp. 83.

THE AWAKENING COLLEGE, *by* C. C. LITTLE, formerly President of University of Michigan. Pp. 282. 15 Chapters. Price $3.00. W. W. Norton & Co., Inc., New York. 1930.

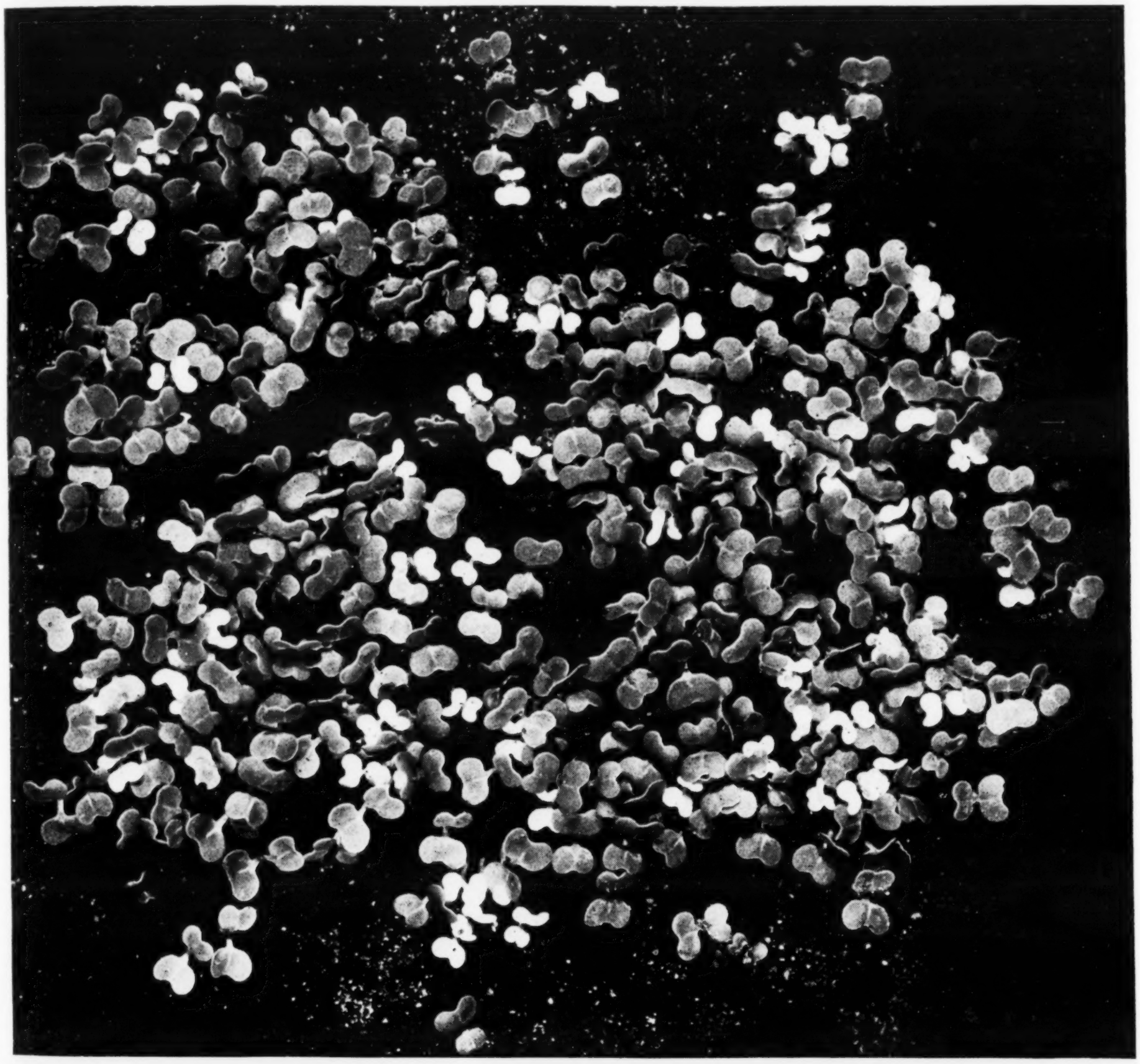
LES PRINCIPALES VARIETES DE BLES CULTIVEES AU MAROC, *by* EM. MIEGE. Pp. 38. 14 Full Page Illustrations. L'Imprimerie Francaise, Casablanca. 1930.

THE "NOBLE EXPERIMENT," *by* IRVING FISHER assisted by H. BRUCE BROUGHAM. Pp. 492. 22 Chapters. 43 Tables. 16 Graphs. 5 Illustrations. Price, $2.15 Postpaid. The Alcohol Information Committee, New York. 1930.

AN ALBINO MUSTARD

O. H. Pearson

Division of Truck Crops, University of California, Davis



GREEN AND ALBINO MUSTARD SEEDLINGS

Figure 13

Seed pan showing young seedlings of a plant of Chinese mustard species segregating for albino seedlings. Of 733 seedlings 585 were green and 188 albino, almost exactly the proportions that would be expected if the self-pollinated plants producing albino seedlings were heterozygous for single Mendelian factor determining albinism.

ALBINO seedlings appeared in the progeny of a mustard plant selfed at Davis, California, in the spring of 1929. These did not develop chlorophyll and died as soon as the reserve food in the cotyledons was exhausted.

The plant which produced these albinos was one of a "Seeds and Plants Introduced" lot, number 63161, introduced from Peking, China, in 1925. This introduction is a member of the species *Brassica campestris* and is known in China as "Piao er Ts'ai (calabash vegetable)". It has very dark green slightly wrinkled leaves,

narrowly decurrent along the petiole, and in general closely resembles one of the darker varieties of savoy spinach. A number of selfed seeds were secured from one of these plants, and on growing a small number of these during the following winter four albinos were observed among 16 seedlings (lot 12-8-29). More seeds were planted and the results are shown in the following table.*

The seed was germinated in sterile soil. There were 69 albinos among the 314 seedlings secured (lot 1-31-30). Since no count was made of the seeds planted it was thought that the deficiency of 9.5 albino seedlings might be due to a weakness in germinating, and that some of the albinos could not get through the soil. Accordingly seed was planted on moist cotton in a covered glass dish, and 94 albinos appeared among 312 seedlings (lot 4-7-30). Only one seed failed to grow although several were very slow and had great difficulty in getting out of their seed coats; these were mostly seedlings having green cotyledons. Undoubtedly in the trial on the soil some seedlings failed to appear, but there is no evidence that the number of albinos among them was abnormally large. These fluctuations are undoubtedly due to random sampling. The total number of seedlings, 733, produced 188 albino seedlings, a very close agreement with the expected, if this character is dependent on a simple mendelian recessive.

The presence of albino seedlings has been reported in many families of plants; especially in the *Graminae*. Reported instances of albinos in plants of dicotyledonous families are fewer. Tjebbes and Kooiman[5] report an albino bean which was perpetuated by grafting onto its normal sibs; the grafted albino produced seed, and these seeds albino beans. A lethal character such as this would be eliminated in a very short time in beans due to their natural habit of self-pollination. Lethals are more often found in cross-pollinated plants. Trow[4] describes the inheritance of the character for chlorophyll-free seedlings in a cross between two varieties of *Senecio vulgaris L.* as dependent on a double recessive condition. Baur[1] describes the behavior of the "Aurea" type of *Antirrhinum majus* L. as the simple heterozygote of a chlorophyll-free and the normal type of plant, the recessive form never appearing, due either to low viability or to failure of the zygote to develop after fertilization. Haage and Schmidt[2] found a similar situation in *Pelargonium zonale "Verona,"* except that the recessive form did appear as nearly white seedlings. Kirk[3] found albinos in some lines of inbred alfalfa and clover, the ratios suggesting a rather complex type of inheritance, the lack of chlorophyll dependent on two or possibly three recessive factors. As far as I know, albinos have not been reported previously in the Cruciferae, and the inheritance of this character may not be as simple as the included data from this one plant seem to indicate.

***TABLE I—Segregation of Mustard Seedlings for Albinos**

Date of observation	Total plants	Albinos	Expected	Deviation	Dev. P. E.
12- 8-29	16	4	4.00	0.00	0.00
1-31-30	314	69	78.50	—9.50	1.83
2- 6-30	91	21	22.75	—1.75	.63
4- 7-30	312	94	78.00	+16.00	3.11
Totals	733	188	183.25	+4.75	.60

Literature Cited

1. Baur, E. Untersuchungen über die Erblichkeitsverhältnisse einer nur in Bastardform lebensfähigen Sippe von Antirrhinum majus. *Deut. Bot. Ges.* 25:422-454. Berlin: 1907
2. Haage and Schmidt. Citation from Baur.
3. Kirk, L. E. Self fertilization in relation to forage crop improvement. *Sci. Agri.* 8:1-40, 1927.
4. Trow, A.H. On "albinism" in *Senecio vulgaris L. Jour. of Genetics* 6:65-74. 1916.
5. Tjebbes, K. en Kooiman, H. N. Erfelijkheidsonderzoekingen bij Boonen. III. Albinisme. *Genetica* 1:532-538—English Summary 536-538. 1919.

Mental Deficiency in Australia

As a result of a resolution passed by the federal health council at its second session in 1928, that it was urgently necessary to have reliable information concerning the extent of mental deficiency in Australia, the commonwealth government appointed Dr. W. Ernest Jones, inspector general of the insane for Victoria, to investigate and report on the subject. The task was colossal. Dr. Jones interviewed federal and state medical officers all over the commonwealth, and the heads of education, lunacy, penal, children's welfare and other agencies in the states. He visited private institutions, blind, deaf and dumb asylums, epileptic colonies, and government and private mental hospitals. Inquiries had to be made from 12,000 schools and 1,100,000 school children. Dr. Jones found that there were 831 idiots of school age in schools, psychopathic hospitals and institutions (494 males and 337 females); 7,216 definite mental deficients (4,380 males and 2,836 females); 14,170 borderline cases (8,245 males and 5,875 females); and 22,217 mental defectives of all classes (13,169 males and 9,048 females).

Of the mental defectives in state psychopathic hospitals, Dr. Jones classifies 436 males as idiots, 1,662 as imbeciles, 210 as feebleminded, 76 as moral deficients; and 370 females as idiots, 853 as imbeciles, 179 as feebleminded, 37 moral deficients, and 1,439 all classes, making a total of 3,323. In other institutions there were 1,360 patients.

Allowing for the difference in the method of examination between New South Wales and the other states, Dr. Jones fixes the percentage of mental deficients in the whole of Australia at 2.89. This includes all classes, from the deeply idiotic to the borderline cases, for whom specialized training and education are essential. If, however, the figures are taken as they have been returned, the percentage will be 2.12, and this will give a final estimate of 22,217 persons between the ages of 6 and 14 years who are mentally deficient.

Dr. Jones recommends that the following measures be instituted to deal with this problem: (1) detection and segregation of mental deficients with arrangements for their appropriate training and guardianship; (2) sterilization of the unfit; (3) legislation on the marriage problem by which only those individuals who are fit mentally and physically to enter into wedlock should be permitted to do so; (4) elimination of syphilis from the community; (5) prohibition of alcohol, or, at least, the enforcement of laws providing for its use rather than its abuse.

Dr. Jones strongly recommends the establishment of a psychologic clinic in each state for the examination of all mentally defective children and young adults, the clinic to comprise a medical practitioner with experience in psychiatry, and a staff of social workers, and he thinks that the best way to make it efficient is to attach it to a children's court. He also advocates the establishment of residential schools for high grade mentally defective children, as in Glenfield, New South Wales; residential colonies for adults who are capable of a certain amount of manual, industrial and domestic training; a system of boarding out, or guardianship, in conjunction with residential colonies; and special blocks for hopeless idiots.

The report adopts a conservative attitude toward sterilization of the mentally deficient. Dr. Jones feels inclined to be influenced by

the British attitude, which, he says, is conservative but is based on a genuine belief that it is not likely to be generally effective and not infrequently ill results to the individual will follow, and that, although many individuals with mild degrees of defect and who are not immediately in need of institutional care and the chief danger in the matter of procreation, segregation and guardianship are infinitely preferable.

Jour. Amer. Med. Assoc.:
1335-6. Apr. 26, 1930.

Andree De Vilmorin

Illustration on Cover

THE firm of Vilmorin-Andreux & Cie of Paris, one of the most celebrated seed growing and seed distributing agencies in the world, is undoubtedly the oldest of such establishments, with a record of unbroken activity since 1727. In 1774 the first of the Vilmorins joined the firm (by marriage), and the business has been handed on from father to son ever since. The firm's distinguished career in the business world has been paralleled by the scientific contributions and the contributions to breeding practice of its members. One of the most successful ventures in breeding undertaken by the Vilmorins was the development of the sugar beet, although in school histories the House of Bonaparte rather than the House of Vilmorin gets the credit.

It appears that even more specialized sources of information may have erred in assigning honors in the development of the sugar beet. Quite generally this accomplishment is credited to Louis de Vilmorin (1816-1860), who undoubtedly did carry on the selection work that developed from the common beet varieties rich in sugar.* He is also generally credited with the development of the principle of "genealogical selection" which made the venture a success. This apparently is not true, as the real originator of this principle appears to be Louis' father, Andree L. de Vilmorin (1776-1862). In a letter to Willet M. Hays dated March 12, 1910, Philippe de Vilmorin (1872-1917) says: "[The second picture] is my grandfather, Louis L. de Vilmorin (1816-1860) who put into practical use his father's principles, especially for the selection of the sugar-beet."

Thus it appears that current statements crediting Louis de Vilmorin with the origination of the progeny test should be revised. Success in the *application* of the principle was undoubtedly his, but to his father should go the honor of discovering the principle of "genealogical selection," and since he survived his son by two years we may even wonder whether he did not take a more active part than is generally believed in applying the principle which he first enunciated.

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*Hagedoorn, who was for many years a geneticist in the service of Vilmorin & Cie., states the matter in the following terms: "The system of selection of wheat and oats which consists of a comparison of the progeny of a great number of individual plants and which was originated by Louis de Vilmorin is more than half a century old." (Relative Value of Processes in Evolution.) Statements of similar tenor are to be found in many other publications.

RACE SEGREGATION IN SOUTH AFRICA

New Policies and Factors in Race Problems

A REMARKABLE pronouncement on race questions appeared in a lecture by General Jan Smuts, delivered recently at the University of Oxford. It is titled as "The Native Policy of South Africa," and undoubtedly will mark a turning point in the history of race relations in the British Empire. The racial experience of South Africa is embodied in a closely-reasoned statement, new views are set forth, and old absurdities left behind. Considering the subject and the occasion, a more effective presentation would be difficult to conceive.

The ideals of race relations developed and followed in the last century are formally condemned and abandoned. The essential differences of the races are not ignored or minimized. A biological viewpoint is closely approached, if not definitely attained. Instead of a future of amalgamation and assimilation of the African and the European races, which reckless reformers have projected, the outlook presented for South Africa is to separate communities which are to remain distinct and develop on different racial lines. The native system of tribal organization is to be carefully preserved in the future, instead of being displaced by European control. This change of policy is held to be justified by the deepest consideration for the natives, and as the only practical alternative to social and political chaos which missionary efforts in Africa have tended to bring about.

Such reactions in South Africa undoubtedly will affect other countries and arouse more interest in the study of the race problems in the United States. More adequate knowledge is the only hope of relieving the sectional tensions that still distort our national life, two generations after the close of the Civil War. The reasons given for the changed policy in South Africa need to be checked carefully from the standpoint of our American race questions.

The New Objective

"The new departure is most far-reaching and has come none too soon. Already the African system is disintegrating everywhere over the whole African continent. Many factors have combined to produce this situation. Missionaries share the blame with administrators, the fight against the native religious ideas has been no less destructive than the deposition of native chiefs and the institution of European organs of government. Unfortunately the earlier efforts of missionary enterprise were made without any reference to or knowledge of the peculiar native psychology, or the light which anthropology has thrown on the past of human cultures. For the natives religion, law, natural science, social customs, and institutions all form one blended whole, which enshrines their view of the world and of the forces governing it. Attack this complex system at any single point, and the whole is endangered. The introduction of the Christian religion meant not only the breakdown of the belief in primitive spirits, in magic and witchcraft, and the abandonment of the practice of polygamy; it meant the breakdown of the entire integral native *Weltanschauung* or outlook on life and the world. A knowledge of anthropology would have enabled the missionary to differentiate between what was barbaric and degrading in the native system and what was merely different from the Christian European system without being morally or socially harmful to the natives. But for the missionary good and bad and indifferent in native practice were met with the same ban, so long as it was not in the Bible or the advanced practice of Christian Europe. The whole tendency of the Christian mission has therefore been to hasten the disintegration of the native system, both in its good and its bad aspects. To this has been added the introduction of the white man's administration through his own official organs, the breakdown of the authority of the chiefs and the tribal system, and the loosening of the bonds which bind native society together, with the consequent weakening or disappearance of tribal discipline over the young men and women of the tribe. The general disintegration has been powerfully reinforced by the improvement of means of transport, the opening of communications and labour

recruitment which have led to the movement of natives and their mix-up on a scale which would have been impossible before. The events of the Great War on the African continent have also contributed to the general disintegration. If the bonds of native tribal cohesion and authority are dissolved, the African governments will everywhere sit with vast hordes of detribalized natives on their hands, for whom the traditional restraints and the discipline of the chiefs and the elders will have no force or effect. The old social and religious sanctions will have disappeared, while no new sanctions except those of the white man's laws will have been substituted. Such a situation would be unprecedented in the history of the world and the results may well be general chaos. The natives of Africa have from time immemorial been subject to a stern, even a ruthless discipline, and their social system has rested on the despotic authority of their chiefs. If this system breaks down and tribal discipline disappears, native society will be resolved into its human atoms, with possibilities of universal Bolshevism and chaos which no friend of the natives or the orderly civilization of this continent would contemplate with equanimity. Freed from all traditional moral and social discipline, the native, just emerging from barbarism, may throw restraint to the winds and give free rein to the brute that is in him even more than in the civilized European. Such a breakdown must be prevented at all costs, and this should be done in a way which will continue to maintain in the future the authority which has guided native life in the past. In the interests of the native as well as those of the European administrations responsible for their welfare, we are called upon to retrace our steps, to take all proper measures which are still possible to restore or preserve the authority of the chiefs, and to maintain the bonds of solidarity and discipline which have in the past supported the tribal organization of the natives. This authority or discipline need not be exercised in a barbarous way and should be shorn of all its old-time cruel or other undesirable features. But in essence it should be maintained, and under the general supervision and check of the European magistrate it should continue to be exercised. Special means should be taken to instruct chiefs in their duties, and the sons of chiefs and headmen should be trained to the proper, exercise of the leadership which they may be called upon to fill. Such schools already exist, not only in South Africa, but under the Tanganyika and Uganda administrations, and may prove most helpful in preserving the traditional native chieftainship and headmanship as a vital link in the organization of native society."*

The tendency of missions undoubtedly has been to break down the controls exerted through tribal customs and superstitions. Without the sanctions of cruelty and fear, the authority of the chiefs may be difficult to maintain. The natural inclinations of negroes are not to monarchic control, or to other specialized forms of social organization. Negroes are gregarious, and perhaps for that reason are not socially minded. Primitive people with group habits of life apparently do not develop civilizations. Living in separate families apparently is necessary to provide constructive associations of parents and children, so that the experience of the race can accumulate.†

Except for maintaining the authority of the chiefs, the proposed segregation of the races apparently is analogous to the establishment of reservations for tribes of Indians in the United States. This reversal of policy is held to be necessary as a means of preserving the racial heritage of the African. Carried to a logical conclusion, such a program of racial patriotism might call for the restoration to Africa of other portions of the race, isolated in foreign countries.

Helping free negroes from America to return to West Africa was one of the first efforts for solving the race problem. Liberia was established as a colony of American negroes, but the undertaking was thoroughly mismanaged and was bitterly opposed by the Abolitionists, as "in league with slavery". The civilized negroes in Liberia, as studied by the writer many years ago, had a prospect of which they were not assured in America. The negro shows to better advantage

*Smuts, Jan C. *The African World*, No. 1412, Vol. CIX, Saturday, Nov. 30, 1929, Page xii.

†Cook, O. F. 1912. Definitions of two primitive social states. *Jour. Wash. Acad. Sci.* 2:125-129.

against his native African background than anywhere else.

Different Policies Compared

It is clear that a race so unique and so different in its mentality and its cultures from those of Europe, requires a policy very unlike that which would suit Europeans. Nothing could be worse for Africa than the application of a policy, the object or tendency of which would be to destroy the basis of this African type, to de-Africanize the African and turn him either into a beast of the field or into a pseudo-European. And yet in the past we tried both alternatives in our dealings with the natives. First we had looked upon the African as essentially inferior or sub-human, as having no soul, and as being only fit to be a slave. As a slave he became an article of commerce, and the greatest article of export from this continent for centuries. But the horrors of this trade became such that the modern conscience finally revolted and stamped out African slavery peacefully in the British Empire, but in America with the convulsions of civil war and a million dead. Then we changed to the opposite extreme. The African now became a man and a brother. Religion and politics combined to shape this new African policy. The principles of the French Revolution which had emancipated Europe were applied to Africa; liberty, equality and fraternity could turn bad Africans into good Europeans. The political system of the natives was ruthlessly destroyed in order to incorporate them as equals into the white system. The African was good as a potential European; his social and political culture was bad, barbarous, and only deserving to be stamped out root and branch. In the British possessions in Africa the native just emerging from barbarism was accepted as an equal citizen with full political rights along with the whites. But his native institutions were ruthlessly prescribed and destroyed. The principle of equal rights was applied in its crudest form, and while it gave the native a semblance of equality with the white, which was little good to him, it destroyed the basis of his African system which was his highest good. These are the two native policies which have prevailed in the past, and the second has been only less harmful than the first. If Africa has to be redeemed, if Africa has to make her own contribution to the world, if Africa is to take her rightful place among the continents, we shall have to proceed on different lines and evolve a policy which will not force her institutions into an alien European mould, but which will preserve her unity with her own past, conserve what is precious in her past, and build her future progress and civilization on specifically African foundations. That should be the new policy, and such a policy would be in line with the traditions of the British Empire. As I said on an occasion which has become historic: the British Empire does not stand for assimilation of its peoples into a common type, it does not stand for standardization, but for the fullest freest development of its peoples along their own specific lines. This principle applies not only to its European, but also to its Asiatic and its African constituents. (Smuts, *l. c.* p. x.)

The new policy is credited to Cecil Rhodes, including the proposal "to restore direct native rule to the natives in their local tribal affairs". Many writers have assumed that the negro was degraded through slavery from high standards of native attainment, as may be implied in the reference to "his African system which was his highest good." It may be that General Smuts sees in the native system something of greater value to the Africans than their contacts with the white race, but these encouraging features are not stated. This is a critical point which should be met clearly, in view of the strictures on missionary policy. If the native system has real values it undoubtedly should be rescued and restored. Otherwise the appeal to the race to "build her future progress and civilization on specifically African foundations" will prove quite as illusive as the man-and-brother formula of equality that was expected to re-create the African. The difficulties of the African field have made it a special challenge of faith. A "saved savage" seemed a greater miracle of grace, a greater "adventure of the spirit" than converting a civilized sinner. The out-pour of missionary enthusiasm in the last century has been as remarkable as the Crusades, and the ultimate effect may be as far from the original purpose.

It may appear that more effective control can be exercised through the tribal system than by treating the natives as members of white communities, but the system is now to be "shorn of all its old time cruel or

other undesirable features". The customs of communal land-holding especially are condemned as wasteful and destructive, and are to be replaced by "better methods of agriculture". The forests and the soil are to be preserved by establishing "a general system of individual agricultural holdings" in place of the shifting tribal habits. A highly developed art of agriculture will be needed if the land is to be kept in permanent cultivation, as now proposed.

Effects of Native Agriculture

. . . . The native system of land socialism is not only primitive but most wasteful in its working. Why should the native farmer improve and render productive what belongs to the community and may be taken away from him by the community? The result is that these communal farm lands rapidly deteriorate and become exhausted, and have to be abandoned after a few years' use. Then the farm lands shift to another area of the tribal domain where the same process of uneconomic exhaustion is repeated. And in the course of years this shifting cultivation works havoc with the natural resources of the domain; the soil is progressively exhausted, the forests and trees disappear, the natural vegetable covering is destroyed, soil erosion sets in, the rainfall is lessened, and what water does fall flows off in torrents, arid conditions arise, and the tribal lands become a barren waste. This sad phenomenon can in one degree or another to-day be seen all over the African continent. Not only in South Africa, but in many other parts of the continent a native area or reserve can be recognized at a distance by the obvious general deterioration of the natural vegetation and the soil. But for the enormous natural resources and recuperative power of the continent, most of Africa would by now be a howling wilderness, because of the wasteful rural economy of its population. Unless the carrying capacity of the land is to be gravely impaired in the future, steps will have to be taken everywhere to preserve the forests and the soil and to teach the native better methods of agriculture. Practical agricultural education must indeed become the principal subject of native education. But nothing will have a more far-reaching effect than a general system of individual agricultural holdings under proper safeguards. The economic incentive to use properly and to improve what is one's own is more powerful than any other factor of progress. In a world tending more and more towards general socialism, the vague phrase of "native socialism" may sound attractive, but its practical effects in Africa are everywhere devastating, and it has on this continent significantly maintained the most backward conditions to be found anywhere on the continents of the world. (Smuts, *l. c.* p. xii).

Nevertheless, the "wasteful rural economy" is an essential feature of the native tribal system. Imposing the European system of individual holdings, and giving the natives "practical agricultural education", will be as long a remove from the usual conditions of tribal life for the African as it is for the Indians in America, when their tribal lands are allotted and farmed individually. With the African natives protected from wars, epidemics and famines, the problems of over-population may be encountered in a few generations.

No intimation is given of the effect that this new policy of agricultural development of the natives is to have on the white population, whether the structure of white civilization is still to rest on native labor, or is to be made self-supporting. The need of separate communities is insisted upon, but this is urged entirely on the ground of the assumed advantage to the natives. The existence of "detribalized" natives is recognized as one of the difficulties of applying the new policy in the Cape districts, and the new communities farther north are urged to apply the new policy "from the very start."

Need of Separate Communities

. . . . . The old practice mixed up black with white in the same institutions, and nothing else was possible after the native institutions and traditions had been carelessly or deliberately destroyed. But in the new plan there will be what is called in South Africa "segregation"—separate institutions for the two elements of the population living in their own separate areas. Separate institutions involve territorial segregation of the white and black. If they live mixed together it is not practicable to sort them out under separate institutions of their own. Institutional segregation carries with it territorial segregation. The new policy therefore gives the native his own traditional institutions on land which is set

aside for his occupation alone. For agricultural and pastoral natives large areas or reserves are set aside, adequate for their present and future needs. It must, however, be admitted that in South Africa grave mistakes in the past have rendered the setting aside of sufficient lands for the natives impossible at present. For urbanized natives who live as domestic servants or industrial workers in white areas, townships or "locations," as they are called, are set aside adjoining to the European towns or cities. In both rural reserves and town locations the natives take a part in or run their own local self-government. Such is the practice now in vogue in South Africa. The system is accepted and welcomed by the vast majority of natives; but it is resented by a small educated minority who claim equal rights with the whites. It is, however, evident that the proper place of the educated minority of the natives is with the rest of their people of whom they are the natural leaders and from whom they should not in any way be dissociated.

. . . . . If we had to do only with the tribal native voters, the question would not be so difficult, and the application of the general segregation principle to the particular case of political rights might be justified. Unfortunately very large numbers of detribalized natives are spread all over the Cape and are no longer resident or registered in the native areas. These urbanized natives constitute the real crux, and it is a difficulty which goes far beyond the political issue. They raise a problem for the whole principle of segregation, as they claim to be civilized and Europeanized and do not wish to be thrust back into the seclusion of their former associations or to forego their new place in the sun among the whites. With the application of strict education and civilization tests it would probably be the better course to allow them to exercise their political rights along with the whites. Were it not for the case of the urbanized or detribalized natives, the colour problem, not only in South Africa but elsewhere in Africa, would be shorn of most of its difficulties. And the situation in South Africa is therefore a lesson to all the younger British communities farther north to prevent as much as possible the detachment of the native from the tribal connection, and to enforce from the very start the system of segregation with its separate native institutions (Smuts, *l. c.* p. xiii).

The segregation policy, like slavery and emancipation, may be viewed as an effect of economic conditions and advancing civilization. Economists have pointed out that the system of slave labor became too expensive to be maintained, and other race contacts are proving too expensive. The tendency of the races to draw further apart is indicated in the United States, hardly less than in South Africa. The contacts tend to be limited to hours of employment, and the range of employment becomes more restricted. Testimony agrees that mixed associations are vastly less at the present time than in the days of slavery. Reports of abnormal conditions in Harlem and Chicago are not significant, since urban negroes are eliminated even more rapidly than whites.

Lack of employment for educated negroes no doubt may help to produce the effect that General Smuts desires, of making them function as leaders of their people. Many are serving as agitators against social inequality, which negroes are now being taught to resent, though slavery was not resented, and was a native African institution. White masters were preferred by the slaves, and the preference of intelligent negroes for white communities shows the same inclination, but often is blamed as a lack of "race loyalty," the new virtue that white negrophiles have invented.

The motive of civilizing and Christianizing the negro served in one century as an argument for slavery, in the next century as an argument for emancipation, and now appears as an argument for segregation, under the new proviso of guarding and preserving the distinctive characteristics of the negro. That both races apparently are being handicapped and perverted by the existing relations, strengthens the argument for segregation, even if no prospect is seen in the "African system". The northern Abolitionists believed that emancipation would place the negro on the same footing as white farmers and wage-earners, but the general effect has been to reduce the rural white population to the economic status of the freedmen, as tenants and share-croppers. The rapid extension of the crop-loan system has

led to the present "farm crisis". A peasant class of low-standard dependent farmers is being bred. The farm questions and the race questions are not far apart.

Giving the negro the status of a white laborer was not a kindness that he could appreciate, having no natural inclination to continuous exertion or social responsibility. A native man in West Africa works hard for three or four weeks in the farm-cutting season, and during the remainder of the year is largely a gentleman of leisure, leaving the other work to the women. That negroes should be willing to work all the time like white men is not reasonably to be expected. It is a discipline for which their racial habits have not prepared them. The reaction against labor by negroes who can avoid it is entirely natural.

Anthony Trollope wrote of Jamaica in 1859: "The negro's idea of emancipation was and is emancipation not from slavery but from work. To lie in the sun and eat breadfruit and yams is his idea of being free. Such freedom as that has not been intended for man in this world; and I say that Jamaica, as it now exists, is still under a devil's ordinance". But the different races are not to be viewed justly from the same standpoint, as General Smuts now pleads:

African Race Characters

What is wanted in Africa today is a wise far-sighted native policy. If we could evolve and pursue a policy which will promote the cause of civilization in Africa without injustice to the African, without injury to what is typical and specific in the African, we shall be rendering a great service to the cause of humanity. For there is much that is good in the African and which ought to be preserved and developed. The negro and the Negroid Bantu form a distinct human type which the world would be poorer without. Here in this vast continent with its wide geographical variety and its immense climatic differences this unique human type has been fixing itself for thousands of years. It is even possible, so some anthropologists hold, that this was the original mother-type of the human race and that Africa holds the cradle of mankind. But whether this is so or not, at any rate here we have the vast results of time, which we should conserve and develop with the same high respect which we feel towards all great natural facts. This type has some wonderful characteristics. It has largely remained a child type, with a child psychology and outlook. A child-like human cannot be a bad human, for are we not in high spiritual matters bidden to be like unto little children? Perhaps as a direct result of this temperament the African is the only happy human I have come across. No other race is so easily satisfied, so good-tempered, so care-free. If this had not been the case, it could scarcely have survived the intolerable evils which have weighed on it like a nightmare through the ages. A race which could survive the immemorial practice of the witch doctor and the slave trader and preserve its inherent simplicity and sweetness of disposition must have some very fine moral qualities. The African easily forgets past troubles and does not anticipate future troubles. This happy-go-lucky disposition is a great asset, but it has also its drawbacks. There is no inward incentive to improvement, there is no persistent effort in construction, and there is complete absorption in the present, its joys and sorrows. Women, wine, and song in their African forms remain the great consolation of life. No indigenous religion has been evolved, no literature, no art since the magnificent promise of the cave-men and the South African petroglyphist, no architecture since Zimbabwe (if that is African). Enough for the African the simple joys of village life, the dance, the tom-tom, the continual excitement of fighting which causes little bloodshed. They can stand any amount of physical hardship and suffering, but when deprived of these simple enjoyments, they droop, sicken and die. Travellers tell how for weeks they would move impassive in horrid slave gangs; but when they passed a village and heard the pleasant noises of children, the song and dance, they would suddenly collapse and die, as if of a broken heart. These children of nature have not the inner toughness and persistence of the European, not those social and moral incentives to progress which have built up European civilization in a comparatively short period. But they have a temperament which suits mother Africa, and which brings out the simple joys of life and deadens its pain, such as no other race possesses. (Smuts, *l. c.* p. xi).

Variation renders the race characters more difficult to formulate, but differences are not in that account less real. For the race as a whole, these generalizations may not be unfair, but many individual negroes

have abilities and virtues beyond this range. The irresponsible, happy-go-lucky disposition is not universal. Temperamental diversities of negroes may be as wide as ours. It often is not true that the negro feels no inward incentive to improvement, or that he is incapable of sustained effort. The sense of personal importance, the desire "to be somebody", often is more developed than in the white race, and out of proportion to ability, so that failure and brooding disappointment may result. The instinctive self-assertions of rough negroes are beyond civilized repressions. As an eminent negro told me many years ago, "Our people will not be satisfied until they can ride on the palace cars and spit on the seats".

In being strongly attracted to the white race, negroes are unlike the American Indians and other primitive peoples. The ready and faithful acceptance of the white man, gives the negro his power over us, and makes him the danger that he is. His special fondness destroys us, if not resisted. That another race can minister to our vices is our own fault, for us to correct in ourselves, instead of blaming the negroes for being deficient by our standards.

The idea of a mutual antipathy of races, as a primitive prejudice which fair-minded people must try to overcome, is false and superficial. The race tensions are generated after the original reactions are perverted, and the color-line defense of the white race then appears necessary. Cases occur in the South of real friendship, respect and consideration between members of the two races, and possibly would be more frequent if "prejudice" did not exist, but every intelligent negro knows distinctions among his own people as definite as the race lines, and serving like purposes of protection.

Artificial demands for "social equality" are prompted by foolish white friends who make matters worse by bringing the wrong negroes to the front. The really intelligent and cultivated negroes are polite and considerate, with no desire to go where they are not wanted, or to be patronized by the over-zealous whites who consider it their duty to associate with negroes.

Spreading the African Race

The present solicitude for preserving the African may be as gratuitous as the effort in the last century to make him over in our own image. Instead of being displaced readily by other races, he thrives better on the fringe of civilization than if left entirely to himself, like the trumpet-tree of the tropics, which occupies all the abandoned clearings. Much of Africa is sparsely populated in comparison with other areas more recently occupied by negroes. Covering the world with human weeds may be the sequel of our present civilization. The meek and inert may inherit the earth by outlasting the active and aggressive. Several intrusive civilizations in Africa have been obliterated, and the same tendencies are shown elsewhere. The British colonies in tropical America practically have been abandoned to the negroes, and much of the Latin countries.

Many negro districts in our Southern States undoubtedly have gone backward in the last century. White populations were largely displaced by negroes during slavery, and such movements have continued since the Civil War. Withdrawal of white farmers from the "black belts" is a tendency which eventually may make the United States a negro country, as a recent German writer has pointed out. Bell's law of racial deterioration applies also as between races. Removal of the more capable elements of a population tends to a more rapid increase of the less capable, as prudence and self-restraint have less meaning.

Racial Responsibilities

The Smuts enumeration of race characters apparently does not include any of the ingredients that would seem to be necessary for developing or maintaining the proposed new civilization, which is to be "distinctly African". Civilizations are not made to order but have to grow out of the abilities of races. Our European or "Western" civilization is only now reaching the stage of consciousness, where it can begin to take thought of its own racial interests. Making a new and superior race out of the African may be a worthy object, but how much confidence can be felt in the sincerity of such professions?

A Southern writer asks the searching question, "Does the South desire the welfare of the negro?" and the same may be asked of South Africa. The welfare of individual negroes undoubtedly is desired, but not negro welfare as an undertaking of race equality and assimilation. "At no cost is the South willing to jeopard the integrity of white civilization". Giving the negroes more consideration than the whites will not release the tensions, but only ripen "the bitter fruit of a graver racial problem".

Apparently the issue turns on the assumed obligation to develop other races. Is there a true sanction of such responsibility, or only a confusion of thought? What real connection can be seen between classifying humanity into racial groups and applying principles of justice? How many races or tribes are to receive this elaborate consideration and development of their special characteristics. In comparison with such a responsibility, the missionary effort to convert all alike into white Christians was a simple undertaking. Many separate questions are confused in the usual arguments on race justice and race equality. Instead of learning the race differences, we have been persuaded to deny and disregard them.

Even such a disaster as the civil war did not teach us that facts must be determined as the only escape from conflicting opinions. Prejudice grows and genders strife, for lack of mutual knowledge. The North was ignorant of the negro, while the South was unconscious of the effects of slavery, so that neither could understand the other, though both were sure of being right. High sentiments of patriotism were invoked on both sides, but fanaticism and rancor were indulged, in the absence of constructive leadership. A million young men, "the flower of the nation", were sacrificed, but the race problem remained essentially the same. Slavery was a blight on the white race, as many knew in the South, but the North became obsessed with the wrongs of the negroes, and "forgot that there were white people in the South". It was plain from the Southern standpoint that the free negroes and colored people would raise difficult questions, as the North at length is becoming aware. Education and the ballot were to place the African race on a footing of equality in the South, but the educated negroes are now seeking better opportunities in the North, and the race tensions are becoming nation-wide. For a subject that has aroused so much controversy and antagonism a special need of study may be claimed. "In a well-ordered state, even the right must not be brought about in a wrong way".

Effects of Parasitism

That the primitive races should be needlessly debauched and mongrelized, merely because the national divisions of the European race are indulging themselves in a struggle of industrial and commercial competition, is a commentary on our present civilization. The low-plane commercial contacts with the tropical countries, which disorganize and destroy the natives, certainly are no real advantage to the European race, even from the standpoint of furnishing

markets for industrial products. Africa suffers from commercial and political aberrations, no less than from missionary zeal. The over-developed commercialism of our European civilization is a racial liability, instead of an asset.

The better we appreciate our own race, the less we shall wish to exploit the other races, and the more interest we shall take in their varied characteristics. The human diversity, as General Smuts points out, is one of "the great natural facts", which future generations would not thank us for destroying. Reducing humanity to a general mixture would solve the race problems, but by destroying the races, and certainly the life of the world would not be enriched.

The race differences undoubtedly are of the same nature as those that distinguish natural species or varieties and need to be studied and interpreted like other biological facts, before being disturbed or destroyed. Each tribe or separate group of people works out its own solutions of the problems of life, and some of these are of general value. Domestications of plants and animals, and the uses of important natural products, including rubber, quinine, cocaine and ephedrine, were discoveries of primitive peoples. Most of the arts and accomplishments of civilization were not original developments of our Northern races; but came as borrowings from other races. Is our civilization to find better courses of continued development or follow the same courses that have brought the civilizations of other races to destruction?

If we learned to live worthily in the new lands that we occupy, our relations with native races would be more constructive. Except for parasitism, the interests of the races are not necessarily in conflict. It is a false notion of civilization, that it can be sustained by parasitism. "Labor, unhonored by a patrician race, becomes dishonorable when identified with slave labor. Thus industry is sapped at the very root, and all progress is paralyzed". Parasitism is a social and economic error which tends to pervert and destroy civilization. Labor is an indispensable discipline of human development, as necessary for intelligence as for bodily strength and dexterity. The mind grows with the use of the hands. Laborers tend to improve while parasites tend to decline, and selection works against them. "Labor is liberty", to be appreciated and enjoyed. The great eugenic emancipation of the white race will come when we can free ourselves from the delusions of parasitism.

O. F. COOK

Origin of the Term "Tuckapaw" Cattle

The word used in connection with my article on "'Duck-Legged' Cattle in Texas" in the February number of this Journal (Pp. 84-90), and pronounced as if it were spelled "Tuckapaw" originated as follows: The word is correctly spelled "Atakapa" which was a name given to the Indians of the gulf coastal region of Louisiana and of Texas. The initial letter is seldom if ever pronounced. While this name was originally given to the Indians of the coastal region it was applied finally to the prairie lands of Louisiana and the cattlemen pronounced the name as indicated by the spelling used in the original article on "Duck-legged Cattle." For this information I am indebted to L. S. Frierson, Shreveport, Louisiana.

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EVOLUTIONARY FORESTS AND ZOOGENIC TREES

A Review of *The New Evolution*

DURING the past seventy years there have appeared in the zoological profession at Washington two men (Gill and Clark), primarily taxonomists in their tendencies, who have been noted among their colleagues as being omnivorous and phagocytic readers and as almost encyclopaedic in their information. Gill's tendencies led him to general revisions of lower units into higher groups. Clark's tendencies gave expression to detailed descriptions of species and genera of the crinoids resulting in his *opus magnum* ("Monograph of the Existing Crinoids"); in addition he made excursions into the field biology of various groups (as the butterflies and birds) unrelated to his monographic work, and also into the popularization of zoology in terms which interest the laity; more recently, he has entered the field of speculative zoology and has summarized his conceptions in this line in the book now under review.*

If these various activities of the author are held in mind, the reader will understand more clearly the general tendencies of the publication and the differences in evaluation of the contents which occur to him.

The book presents a large amount of data, culled from different phyla, taken from all over the world, presented in an interesting and instructive manner, and described in language which often contains most happy expressions and comparisons. Here the author appears at his best, as known to his intimate friends "in the Club", and he brings to their minds the qualities for which they admire him. This feature of the publication will repay the reader for the time he spends in becoming acquainted with the author.

It is possibly expecting too much of an author that he shall be equally efficient in unusual powers of memory and of observation, of detailed description, and of instructive popularization on the one hand and, on the other, in technical speculation and theorizing, and in logical deduction. If this be so, the reader need not be surprised if he feels a twinge of disappointment (at the philosophical aspects) mingled with his enjoyment (of the more strictly biological data), and if the thought arises in his mind that the author would have done better to hold to that phase of the subject in which his greater strength lies.

Zoogenesis a New Term?

The author defines zoogenesis as follows:

> If we regard the complete history of the development of animal life in this light [three distinct but interrelated phases: evolution, mutation, eogenesis], we must, in order to avoid confusion, use for it an entirely new term. We may call it zoogenesis (p. 169).

Zoogenesis is, however, not "*an entirely new term*". It is an alternate for zoogeny (or zoogony); compare—

> "Zoogeny, no[un].—The doctrine or process of the origination of living animals. —Zoogenesis‡."—Funk & Wagnalls New Standard Dictionary of the English Language, 1922, p. 2754.
>
> "ZOOGENY, Zoogenia, Zoogenesis. The doctrine of animal formation."—Dunglison's Medical Lexicon, 1854, p. 926.
>
> "ZOOGENY, Zoogenia, Zoogenesis. The doctrine of the development and growth of animals."—Harris' Dictionary of Medical Terminology, Dental Surgery, and the Collateral Sciences. 2nd Ed., 1855, p. 800.
>
> "Zoogenesis—The generation of animal forms."—Gould's Practitioner's Medical Dictionary. 3rd Ed., 1918, p. 960.

*CLARK, AUSTIN H. *The New Evolution: Zoogenesis.* 8°. 297 pp. Figs. A-D, and 1 to 136. First run, 1st ed., 250 autographed and numbered copies, $10.00; regular 1st ed., 3000 copies, $3.00. Baltimore. Williams & Wilkins Co. 1930.

Eogenesis is defined (p. 213) as *"the process leading to and resulting in the first appearance of some representative or representatives of each of the major groups"*.

The *"original and primitive single cell"*, which is the common ancestor of all the phyla (p. 220, 235, and fig. A, p. 238), was (according to the author's definition, pp. 244-245, and 271) a protozoon; but (p. 236) *"there is not the slightest basis for"* the *"assumption"* that the protozoa *"preceded all other animal types in their appearance"*, ... *"beyond the circumstance that in arithmetic—which is not zoology—the number one precedes the other numbers"* (p. 236), and (p. 239) *"there is no reason whatever for assuming that complete separation* [cf., however, fig. A, p. 238] *of dividing cells* [protozoa] *is a more primitive condition than adhesion of cells after division* [metazoa], *or preceded adhesion. In fact, the great rarity of complete separation of cells after division in the animal world taken as a whole almost suggests that adhesion* [metazoa], *not separation* [protozoa], *is the primitive condition. Therefore the statement commonly made that the . . . protozoans are the most primitive of the animals, and preceded in appearance the multicellular types, has nothing to support it. The only logical assumption is that the appearance of the"* protozoa and metazoa *"was simultaneous—perhaps even that the latter appeared first* (fig. A, p. 238)"; (p. 241) *"there is not the slightest evidence that any one of these animal types* [protozoa, sponges, coelenterates] *preceded the other two."*

Accordingly, the author presents his conception of *"the primitive single cell"*, proceeds to demolish that conception, and then concludes that *"the only logical assumption"* is not the only logical assumption, but has as alternate another guess.

Evolution.—"Life at its very first beginnings [plural] *from the single cell developed simultaneously and at once in every possible direction. All of the phyla or major groups seem to be of simultaneous development—at least we have no evidence that it was otherwise* [cf., however, fig. A, p. 238, fig. B, p. 240, and fig. C, p. 246]. *From each one of these a separate developmental line or tree arose, growing upward through the ages"* (p. 168).

"The numerous developmental lines are explained by the process of evolution *as that term is commonly understood, and this descriptive word should be restricted to these developmental lines"* (p. 168).

Mutations.—"The gaps within these lines, and between related lines which run more or less parallel, are explained by an extension of the theory of mutations" (p. 168).

Man and Apes

Certain passages which will appeal to many of the lay readers of the book are brought into prominence in the prospectus issued by the publishers. For instance:

> Unfortunately at the present time the broader viewpoint of man's relation to the world at large has among biologists been almost completely superseded by the very narrow viewpoint that the position of man is to be explained entirely on the basis of his dissected body (p. 2).
>
> This narrow viewpoint has been developed in such a way and to such extremes as to lead to conclusions which in their total disregard of man as man cannot but give offense and arouse antagonism (p. 2).
>
> So in the light of all the evidence available at the present time there is no justification in assuming that such a thing as a "missing link" ever existed, or indeed could ever have existed (p. 226-227).

To these might be added:

> Man belongs to the same division of the mammals—the Primates—as the apes. But his similarity to the modern apes does not imply any direct relationship with them. Man is not an ape, and in spite of the similarity between them there is not the slightest evidence that man is descended from an ape (p. 224).
>
> As man and the man-like apes are both very highly specialized, but are specialized in widely different directions, we cannot suppose that either descended from the other, or indeed that there really is any very close relationship between them. The truth of this is now very generally admitted by biologists (p. 225).

If the anti-evolutionist stops here, he will enthusiastically quote the author as one of the staunch supporters of anti-evolution—as a modern Moses who has arisen to lead his narrow-minded scientific colleagues out of their wilderness. But if one reads further, his enthusiasm will wane, for—

> Yet since both man and the apes belong to the same division of the mammals—the Primates—and we cannot doubt the continuity of life from parent to child from the very first, man and the apes must have had at some time in the past a common ancestor (p. 227).

It is to be noticed that the author uses the English term "ape" in the restricted sense, as distinguished from the English term "monkey", and not in the broader sense of the German "Affen", which includes the "monkeys". Accordingly, the author really means that no known anthropoid ape (family "*Pongidae*") is acceptable zoologically as the progenitor of man (*Homo sapiens*) who belongs to the concurrent family *Hominidae*.

In reference to his assertion regarding the "missing link", it is to be noted and regretted that the author does not define what he means by a "missing link", although he states definitely that "*man and the apes must have had at some time in the past a common ancestor*".

The term "connecting link" is rather general in nature, including geologically horizontal and geologically perpendicular "populations", common ancestors, embryological stages and teratological conditions. If a "*common ancestor*" is not acceptable as a "*missing link*" or "connecting link", it is difficult to imagine just what represents the *sine qua non* of a "connecting link" [compare the legal principle in the division of estates], and there might be some difficulty in obtaining an agreement to confine the term to some particular kind of a "connecting link". In reality the author both affirms and denies that there was a "connecting link" between man and apes. Or, to express it in another way, using in part the author's assertions—

1. "*Man and the apes must have had —a common ancestor*" [i. e., a connecting link, or a "missing link"]; but
2. "*There is no justification in assuming that such a thing as a 'missing link' ever existed, or indeed could ever have existed*";
3. *Ergo,* man and apes do not exist and indeed could never have existed.

If the reviewer were to go further into the details (in presenting the line of reasoning, the method of logic, and the *ex cathedra* assertions on points at least some of which are *sub judice,* the numerous repetitions, the inconsistencies and the contradictions, the "sandpaper" test and the "whacking" test as important differential diagnostic features between baby *Homo* and baby monkey, etc. etc.) presented in the "New Evolution" (which the prospectus assures us "may prove to be as epoch-making as the Darwinian" hypothesis), the thought would lie near that the reviewer harbors toward the author a feeling of animosity, instead of friendship.

In brief summary, despite the interesting informational features of the book, the reviewer feels that the author has wandered away from home in the speculative discussion, that he has lost his way in the "*whole forest of evolutionary trees*" (p. 215), and that the book will increase the popular esteem more than it will the professional reputation of his friend and colleague. On the other hand, the speculative portions of the work may possibly produce ultimate good by the discussion which they will provoke, so that this portion too may not be without ultimate educational results.

C. W. Stiles.

A COLOR-MUTATION IN GRAHAM'S WATERSNAKE

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THE tendency toward melanism is not an unusual phenomenon among snakes. In some cases a species will be noticeably darker in one part of the country, so much so that one might readily mistake those from different regions for distinct species. Thus, eastern specimens of the pilot blacksnake *Elaphe obsoleta obsoleta* (Say) present an almost solid black appearance unless their scales are stretched apart to show the whitish edges; while those from Iowa and what the writer has seen from Louisiana show always a very definite light coloration, either whitish or pinkish, at the scale edges, even when these are not stretched apart. This melanic regionism occurs among other groups of animals as well. It is found among certain groups of insects.

Another type of melanism, a sort of sport melanism, is also well known among widely differing groups of animals, just as is its opposite, albinism. The one consists in an excessive and general deposition of dark pigment either over all the skin and its coverings (hair, feathers, scales) or on considerable areas. In the other condition, also known among snakes, the skin is white or pale because of deficiency of pigment. Well-known instances of the former are the black leopard, black squirrel, black woodchunk, black sheep, etc. This is not rare among some genera of the colubrine snakes; the genus Heterodon, comprising the four species of hognose or spreading adder often having perfectly black individuals. Recently a specimen of Pituophis or pine-snake was reported by Dr. Frank Blanchard of the University of Michigan which was black. Both of these genera contain mainly light-colored species. I am not acquainted with any observations on the inheritance of color of these melanic individuals, though it would doubtless be a matter of some interest to geneticists. Inheritance among ophidians might be expected to follow the same lines as are known in other animals in comparable cases.*

Whether the instance here recorded really has anything to do with melanism, even though one of the color phases recorded is very dark, or whether it is merely another example of that variety of color dimorphism so well-known in the common screech owl, *Otus asio,* in which the same brood may exhibit young birds of the gray color phase and others of the reddish brown phase without relation to sex or to known genetic reasons is a pertinent question.

So far as the writer has been able to learn, no one has hitherto recorded the dark color phase in the Graham's watersnake *Natrix grahamii* (Baird and Girard). On July 15, 1928, a water-snake was brought to the writer by Mrs. Elinor Robson, a Nature Study teacher of Des Moines, Iowa. She had herself captured it at a pond in a park within the city limits of Des Moines, and had tried to classify it by the use of available taxonomic keys for the group. She was unable to identify it because it would not fit into any existing keys, being probably hitherto undescribed. Aside from color, however, it answered best to the description of Graham's watersnake, and was regarded by the writer as probably merely an off-color individual of that species.

Graham's watersnake is one of the smaller species of the genus Natrix,

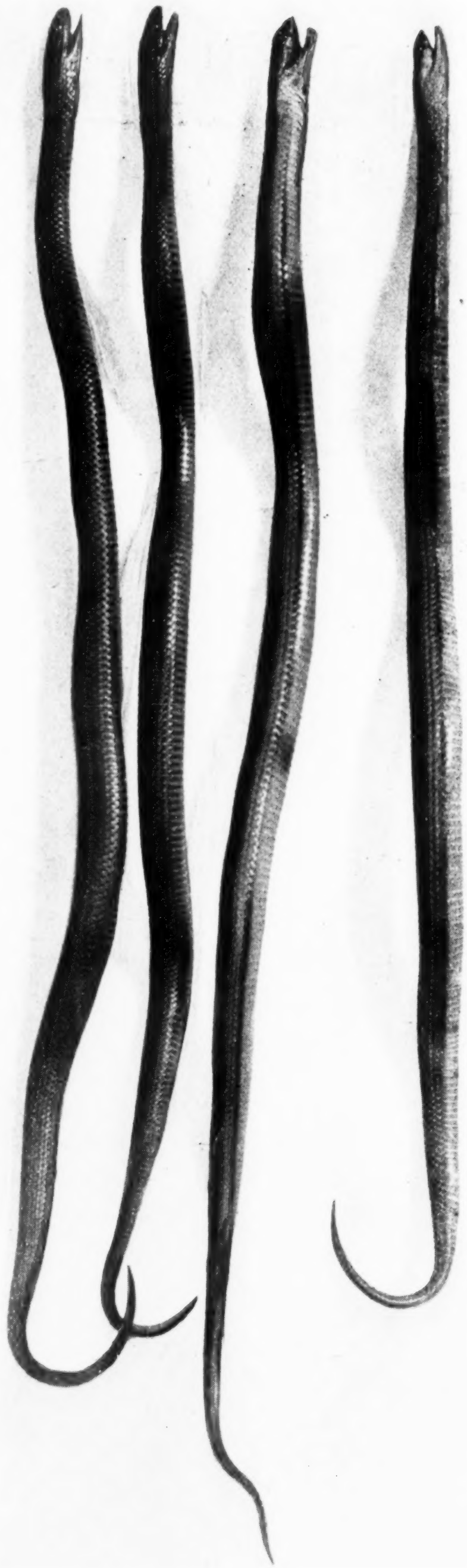
*Since the above was written there have appeared in *Copeia* two papers by E. B. S. Logier on melanism and its inheritance in Thamnophis.

apparently closely related to the *Natrix rigida* of the Gulf States and to *Natrix septemvittata* of the eastern and south-eastern states. From both of these species it is regarded as distinct though the separation is very largely, even exclusively so far as the keys go, a matter of color pattern. The range of *Natrix grahamii* is middle-western and southern, to quote Blanchard* Illinois and Eastern Kansas to Louisiana and Texas. The species is very dark brown, nearly black above with an indistinct median stripe of lighter shade, narrowly bordered by black, sides with definite dark zigzag stripes where the dorsal scales meet the ventral plates, and with narrow dark longitudinal lines higher up on the sides. The ventral side is white or creamy with a more or less well developed median dark line or row of spots on at least part of the abdomen. The specimen under consideration was almost uniformly dark above, leaden beneath except for a *light* median line, and was without markings on the sides which characterize the species. Moreover it had a series of transverse spots near the lateral edges of the ventral plates which are not a part of the usual coloration of the species.

An unusual combination of circumstances indicated the identity of the specimen, so far as species is concerned, and threw further light on the inheritance of color pattern in reptiles.

The little serpent proved to be a mature female, though but 675 m.m. in length, (Full-grown specimens may reach 900 m.m. in length) which had

*Blanchard, Frank N. A Key to the Snakes of the United States, Canada, and Lower California. *Mich. Acad. Sci., Arts and Letters.* Vol. IV, 1924.



MELANIC AND NORMAL COLOR PATTERN

Figure 14

At left are two of the sibs with melanic pattern; at right, two with the normal color pattern of *Natrix grahamii.* The mutants entirely lack the light colored ventral surface and the stripe along the side.

SEGREGATING FOR MELANISM
Figure 15

Nine individuals of a progeny of ten snakes borne by a melanic female watersnake (*Natrix grahamii*). The four on the left are of the melanic pattern and the rest of the litter had the normal pattern of the species.

mated before her capture. On September 10, 1928, she bore ten young ranging in length from 205 m.m. to 230 m.m., and averaging about 216 m.m. Unfortunately, six of these were dead when found, having probably died just before or after birth, as all were fresh, and the dead ones averaged as large as those that had survived.

Of the ten, four were colored exactly like the mother, entirely lacking

the white on sides and ventral surface, the conspicuous lateral stripes and the dark mid-ventral line or row of spots, all of which belong to the distinctive color pattern of the species. The other six were typical *Natrix grahamii* in all respects.

Genetically, the effects of this uncontrolled mating with what was probably a normally colored male are rather interesting. It seems likely in the first place that this abnormal "black sheep" of the species was chosen by (or chose) a normal male in mating, both by reason of the fact that the melanic-pattern ones are probably very rare, having never been previously described; and in the second place because the color-pattern dimorphism of the progeny indicates diverse pattern heritage.

It is probable that color plays little part in sex attraction in serpents, the presence and use of scent glands indicating that odor may be a large factor. The writer once had a black (true melanic) female of the common spreading adder *Heterodon contortrix* (Linn.) which contained fertilized and partly developed eggs in her uterus at the time of her death, and black spreading adders are rare enough so that there was little probability that she had found a black mate.

But to return to the watersnake, four melanic-pattern young from a melanic-pattern mother to six young bearing the normal pattern of the species, and presumably like their sire, is an interesting ratio from the genetic standpoint.

Evidently here is a problem which it would be desirable to follow up for another generation in the interest of genetical studies. Unfortunately, however, snakes of most species do not mate readily when in captivity, seldom becoming sufficiently accustomed to their surroundings to feel at home, even though they may feed regularly and act normally.

The writer has been unable, so far, to find any food which will tempt this snake, and she has consequently had to be fed by hand on egg, liver and meat. It seems unlikely that she will become familiar enough with her cage and surroundings to mate with a normally colored male, even though one should be procured for the purpose.*

The young seemed to be delicate, and it was impossible to rear them.

To summarize: A Graham's watersnake, *Natrix grahamii* (Baird and Girard), taken in Iowa of a hitherto undescribed color pattern, mated before her capture, bore a brood of ten young, of which four were of her own peculiar (melanic) pattern, while the remaining six were marked with the color pattern characteristic of the species.

*The snake finally died and has been sent, with specimens of both color patterns of young to Dr. Leonard Stejneger, U. S. National Museum, Washington, D. C.—*J. E. G.*